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EXHIBIT A - PROGRAM WORK STATEMENT

PIER PROGRAM GOALS AND OBJECTIVES

The overall goal of the Public Interest Energy Research (PIER) Renewables program is to provide funding to support the development of advanced renewable energy technologies that will help make California's electricity more diverse and affordable. The PIER Renewables Program funds, versus project specific funds, are being provided to facilitate development of linked renewable energy projects that act in a coordinated fashion to make electricity more affordable.

Development efforts are to be focused towards making electricity more affordable for a specific electricity customer class, for electricity customers in a specific geographical location, or to help create a collection of renewable energy technologies, products or services that enhance customer choice across customer class or location. In this program, PIER funds are allocated by four "emphasis areas."

- Emphasis Area 1: Assessing and Targeting Renewable Electricity Development
- Emphasis Area 2: Increasing Affordability by Improving Existing Renewable Energy Facilities
- Emphasis Area 3: Expanding Affordability & Diversity Using Renewable Distributed Generation
- Emphasis Area 4: Developing Renewable Technologies for Tomorrow's Electricity System

The PIER objectives for Emphasis Area 1 are:

- Conducting power flow modeling that identifies existing or anticipated problems with the electricity systems in the targeted region over the next five, ten and fifteen years.
 - Developing or modifying power models as needed to simulate the electricity system down to the distribution line level.
 - Determining electricity needs and potential problems (capacity, power quality, reliability, etc.) over the next five, ten and fifteen years.
 - Identifying performance characteristics of electricity generators needed to help resolve identified problems (e.g., rated capacities, turndown, ramp up speed, dispatchability, blackstart capabilities, emission profiles, capital and operating/maintenance costs, etc.)
- Compiling information on the availability of renewable and fossil resources in the target region and information on critical constraints or issues in the region.
 - Identifying amounts and locations of available energy resources (e.g., natural gas, and renewable resources).
 - Identifying environmental or permitting conditions that may pose special constraints (e.g., air quality, waste disposal, land use, etc.).
- Matching electricity needs and desired affordability goals with desired renewable electricity generation performance and cost characteristics
 - Establishing desired renewable electricity generation performance characteristics for the targeted region.

- Establishing desired affordability electricity goals for the region that set the cost targets for the renewable electricity generation technologies to be developed and used in the target region.
- Developing a plan of coordinated research and development efforts that will enable the desired electricity generation performance characteristics and cost targets to be achieved in the target region.
 - Sets overall goals and objectives to be achieved in the focus area.
 - Specifies the renewable technologies and products to be developed.
 - Provides technology or product specific performance and cost goals

The PIER objectives for Emphasis Area 2 are:

- Improving efficiencies and lowering O&M.
 - Increasing thermal conversion efficiencies (e.g., biomass, solar, geothermal), reducing frictional losses in mechanical systems (e.g., wind, hydroelectric), or reducing electricity losses within the system (all).
 - Employing lower cost fuels (e.g., biomass), lowering resource extraction or collection costs (e.g., biomass, geothermal), or improving maintenance intervals (all).
- Establishing new and diversified revenue streams that help with capital cost recovery and therefore help lower electricity generating costs.
 - Developing value-added byproducts (e.g., chemicals or feedstock,).
 - Increasing use of thermal energy produced from system (all).
- Developing the ability to provide ancillary services or peak generating capabilities.
 - Employing low NO_x co-firing to increase ramp up speed, dispatchability, or peak generation.
 - Developing energy storage technologies as appropriate to provide dispatchability, or peak generation.

The PIER objectives for Emphasis Area 3 are:

- Developing renewable distributed generation technologies that can match the demand profiles of the appropriate demand centers, help defer transmission and distribution expansions or upgrades, provide power quality benefits to the customer or the electricity system, help provide volt-ampere reactive (VAR) support and have very low emissions or other environmental impacts.
 - Development of renewable electricity technologies that will have inherently higher load following or dispatchability capabilities.
 - Development of renewable electricity technologies integrated with energy storage and control systems that enable them to have superior dispatchability, peak generation or load following capabilities.
 - Development of hybridized renewable/fossil electricity technologies that have superior dispatchability, peak generation or load following capabilities.
- Integrating renewable electricity generation technologies and other technologies using dynamic control systems in a manner to produce high performance “mini-grids” capable of providing lower cost power with high availability, reliability, power quality and environmental cleanliness. Note that integration is not limited to renewable energy technologies. Hybrid combinations of renewable and fossil technologies can be used, as well as combinations of building technologies and renewables.

- Conducting field verifications of newly developed renewable distributed generation technologies to assess performance capabilities in full-scale field or commercial settings.

The PIER objectives for Emphasis Area 4 are:

- Creating information and evaluation tools that provide electricity customers the ability to make informed decisions regarding renewable electricity technologies.
 - Establishing a database of information on renewable energy resources available in the customer area, plus general background information on options including efficiency, renewable and fossil technologies.
 - An easy to use and understand evaluation tool that provides approximate sizing and cost of renewable technologies that could be considered by the customer, an estimated impact on overall electricity use and bills, and comparison to other options.
- Developing small, modular renewable electricity products that are highly responsive to customer electricity demands, supply other significant benefits beyond energy, can be integrated in with other customer appliances or other electricity generation technologies, and integrate seamlessly into the customer or environmental settings. Examples may include:
 - Advanced photovoltaic systems that can substitute for a conventional building envelope material, and represent part of an overall electricity control system that can provide power as needed to the customer or to the electricity system (based on demand and price signals).
 - Advanced renewable DC power technologies that are used to provide high efficiency, high power quality to customers, and are integrated in with other efficiency measures or help provide energy for other purposes (e.g., heating, production of hydrogen, etc.).
- Advancing super efficient, super clean renewable electricity technologies for use in industrial or utility system settings. Examples may include:
 - Renewable electricity technologies with seventy percent plus electricity conversion efficiencies, essentially no measurable air pollution emissions, and no discernable environmental impact.
 - Smart renewable energy technologies that have the ability to adjust balances between electricity and energy (e.g., process heat) production, fuel characteristics, thermal and environmental performance to provide responsiveness to changing industrial needs.

COMMONWEALTH PROGRAM GOALS AND OBJECTIVES

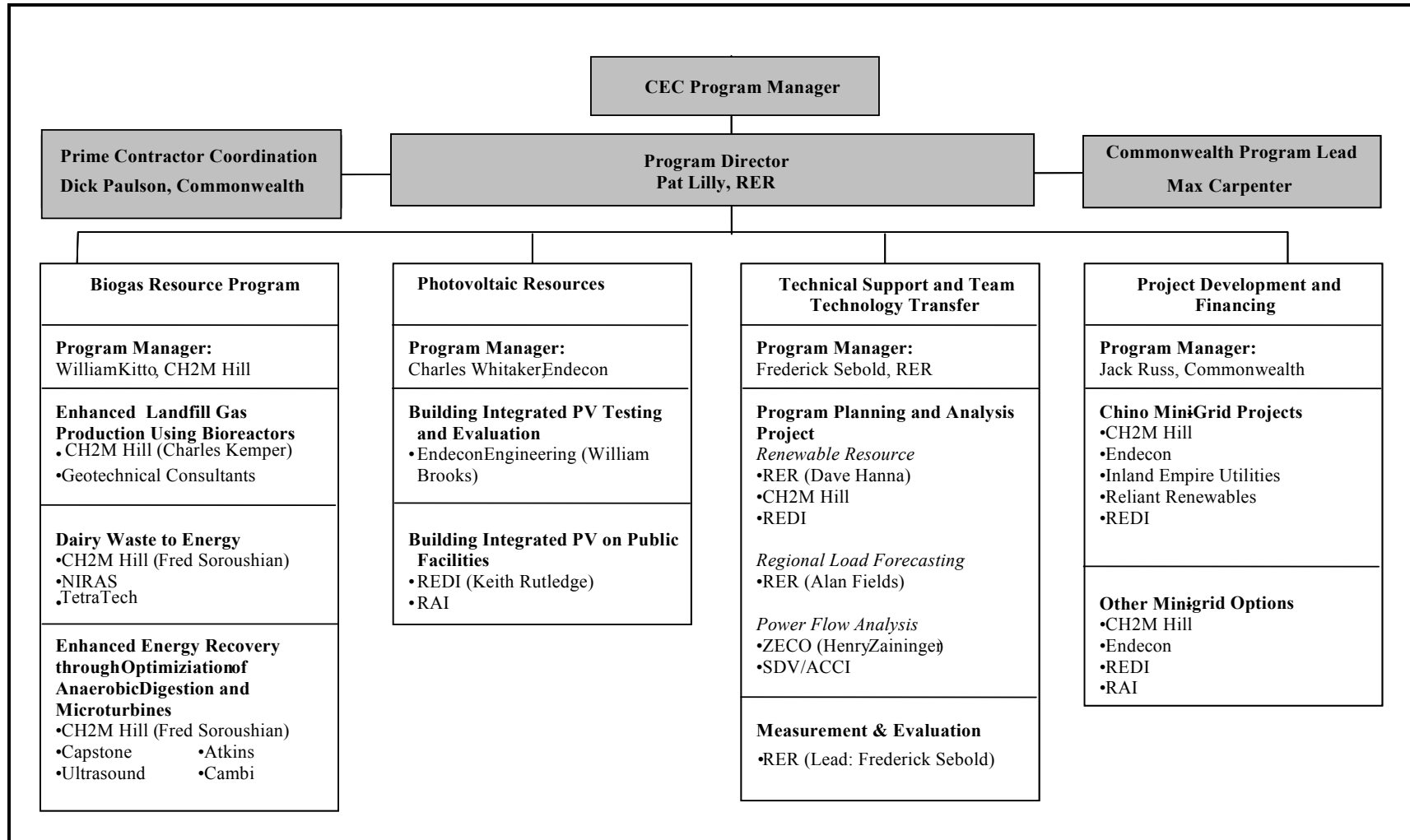
The overall goals of the Commonwealth Biogas/PV Micro-Grid Renewable Resource Program are to:

- Develop and implement an approach for tailoring resource development to the specific needs and resources of local areas, or mini-grids
- Develop means of increasing landfill gas production, accelerating biodegradation and decreasing landfill generation lifecycle costs
- Improve the affordability of renewable energy produced from digester gas at sewage treatment plants
- Improve the economics of producing energy from animal waste
- Demonstrate the use of proper systems integration to enhance the performance of photovoltaic systems
- Demonstrate the use of a basic rating system to improve the flow of information on photovoltaic system performance
- Demonstrate the potential for taking advantage of cost economies by installing relatively large PV systems under common ownership arrangements

LIST OF PROJECTS IN COMMONWEALTH PROGRAM BY PIER EMPHASIS AREAS

Emphasis Area	Projects In Commonwealth Program	
	Project 0	Program Administration
Emphasis Area 1: Assessing and Targeting Renewable Electricity Development	Project 1.1	Program Planning and Analysis Project
Emphasis Area 2: Increasing Affordability by Improving Existing Renewables Investments	Project 2.1	Enhanced Landfill Gas Production Using Bioreactor Project
	Project 2.2	Enhanced Energy Recovery through Optimization of Anaerobic Digestion and Microturbines Project
Emphasis Area 3: Expanding Affordability and Diversity Using Renewable Distributed Generation	Project 3.1	Dairy Waste to Energy Project
	Project 3.2	Building Integrated PV Testing and Evaluation Project
	Project 3.3	Building Integrated PV on Public Facilities Project
Emphasis Area 4: Developing Renewable Technologies for Tomorrow's Electricity System	None	None

GRAPHICAL SUMMARY OF ORGANIZATION CHART



WORK STATEMENT FOR PROJECT 0 - PROGRAM ADMINISTRATION

PROBLEM STATEMENT

The Program Administration element encompasses overall coordination and integration of the technical program elements for the many organizations participating in this program. It is imperative that a process is in place to effectively manage the proposed program to achieve the program and project goals within allocated budget and schedule.

ADMINISTRATIVE GOALS

The Program Director has overall responsibility for managing the program to achieve the specified technical and economic performance goals and to ensure that research results meet guidelines for quality within budget and schedule. This will require coordinating R&D efforts between the technical program elements. The coordination shall include overseeing assessment studies, tracking R&D progress and deliverables, ensuring the quality of RD&D results, identifying and facilitating program linkages between elements, implementing mechanisms to revisit the program's research direction and focus as research results are achieved, ensuring connection with the market and linkage to utility deployment programs, and establishing systems for reliable internal and external communications throughout the contract period.

TASK LIST

This program element's work scope involves the following administrative tasks:

Task 0.1	Kick-Off Meeting
Task 0.2	Program Start-up Activities
Task 0.3	Program Meetings
Task 0.4	Annual Technical Briefings
Task 0.5	Progress Reports
Task 0.6	Final Report
Task 0.7	Final Meeting
Task 0.8	Project-Specific Administrative Tasks

This work statement includes objectives, contractor activities, task deliverables, key personnel and key subcontractors for each of the projects listed above. The deliverables are defined to the extent possible, but are subject to change based on recommendations from the Project Director and the approval of the Commission Contract Manager.

TASK DESCRIPTIONS

Task 0.1: **Program Kick-Off Meeting**

The objectives of this task are to review the Commission's expectations for this contract work, to coordinate activities between multiple PIER Renewables contracts, and to establish an initial schedule for future contract meetings.

The Contractor shall attend a kick-off meeting with the Commission Contract Manager and Contract Officer to review the Commission's expectations for: accomplishing tasks described in the work statement; administrative requirements in the terms and conditions of the contract (e.g.,

invoicing, UCC.1 form filing, prior approvals, data disclosure limitations, monthly progress reporting format and content, etc.), and the Commission's roles and responsibilities.

This kick-off meeting will also accomplish the following contract coordination efforts between the Commission Contract Manager, the Program Director and the Project Leads:

- Establish an initial schedule for future contract meetings including Critical Program Review Meetings, Critical Project Review Meetings, and Renewable Program Advisory Committee Meetings.
- Identify software requirements for all software products developed or enhanced in this contract.
- Concur on the uses of the program management web site.
- Discuss project-specific administrative tasks and the schedule for the individual kick-off meetings.
- Discuss a plan to coordinate the PIER programmatic contracts. At a minimum, this coordination shall include producing and sharing a contact list, web site links, and research bibliographies. The plan shall also include initial schedules and protocols for future research coordination and Program Advisory Committee Meetings.

The Commission Contract Manager shall designate the date and location of this meeting. The Commission Contract Manager will be responsible for recording the decisions, agreements and schedules determined at this meeting. The Program Director is responsible for reviewing these written meeting minutes and providing a written letter to the Commission Contract Manager summarizing the agreements and containing all appropriate planning information.

The deliverables are:

- ✓ Kickoff meeting.
- ✓ Written documentation of meeting agreements and initial schedule for future contract meetings.

Key Personnel:

Pat Lilly

Task 0.2: Program Start-Up Activities

Task 0.2.1: Public Presentation

The objective of this task is to provide PIER stakeholders, interested parties and the general public an opportunity to be introduced to the research, development and demonstration work that will be undertaken in this contract.

The Contractor shall prepare an outline of the goals and objectives of the program and make a 60-minute presentation at a half-day public presentation. This meeting will introduce all three programmatic PIER contracts to the meeting attendees. The Commission Contract Manager shall designate the date, time and location of this meeting. The Commission shall designate the other participants in the public meeting.

The deliverables are:

- ✓ A prepared 60-minute presentation (electronic copy to Commission Contract Manager).

Task 0.2.2: Program Software Standardization

There are three objectives of this task. 1) Unify the file formats of electronic data and documents provided to the Commission as contract deliverables. 2) Establish the computer platforms, operating systems and software that will be required to review and approve all software deliverables, and 3) Establish and maintain a program management web site.

The Contractor shall deliver documents to the Commission Contract Manager in the following formats:

- Data sets shall be in Microsoft (MS) Access or MS Excel file format.
- PC-based text documents shall be in MS Word file format.
- Documents intended for public distribution shall be in PDF file format.
- Project management documents shall be in MS Project file format.
- Presentation documents shall be in MS Power-Point format.

Exceptions to the above file formats must be submitted in a Notification Letter and pre-approved in writing by the Commission Contract Manager.

Computer platforms, operating systems and software requirements for all software deliverables shall be listed in a Notification Letter and approved by the Commission Contract Manager at least 90 days before the software is scheduled to be reviewed by the Commission.

The Contractor shall establish a program management web site. This shall be done in consultation with the Commission Contract Manager. A portion of the site shall be password protected.

The deliverables are:

- ✓ Notification Letter(s) for File Formats.
- ✓ Notification Letter(s) for computer platforms, operating systems and software requirements.
- ✓ Establish Program Management Web Site.

Task 0.2.3: Propose and Finalize the Renewables Program Advisory Committee

The objective of this task is to create an advisory committee for this program. The purpose of this Renewables Program Advisory Committee (RPAC) will be to:

- Provide strategic guidance to the Program Management Team (consisting of the Program Director, the Leads of each project, and the Commission Contract Manager).
- Review current and future deliverables to evaluate functionality of the deliverables.

- Provide specific suggestions/recommendations for needed adjustments, refinements, or enhancement of the deliverables.
- Provide guidance in research direction. The guidance should include, but not be limited to, scope of research; research methodologies; timing; coordination with other research, etc. The guidance may be based on:
 - technical area expertise
 - knowledge of market applications
 - linkages between the programmatic contract work and other past, present or future research (both public and private sector) they are aware of in a particular area
- Evaluate tangible benefits to California and provide recommendations, as needed, to enhance tangible benefits.
- Provide recommendations regarding information dissemination, market pathways or commercialization strategies relevant to the research products.

The RPAC should be composed of 8-12 diverse professionals with both Program development and implementation experience and technical expertise relating to the technologies addressed by the Program. This RPAC size shall be a target that the Contractor strives to achieve. This number can vary depending on potential interest and time availability, however 8 should be considered a practical minimum. The RPAC shall be composed of qualified professionals spanning the following disciplines:

- Researchers knowledgeable regarding renewable energy technologies in the listed projects
- Entities who would use the developed technologies, products or services at the project level
 - Renewable energy project developers (Engineers/Architects)
 - Renewable energy project owners
 - Renewable energy project operators
- Entities who would use the developed technologies, products or services at the systems level
 - Electricity suppliers (as defined in this solicitation)
- Renewable energy product developers
 - Renewable energy equipment and control manufacturers
 - Other product developers relevant to individual emphasis areas and projects in the program
- Public sector decision makers with Program planning, design or evaluation expertise
- DOE renewable energy research managers
- Public interest environmental groups

The Contractor shall recruit RPAC members and ensure that each individual understands the member obligations described above, as well as the meeting schedule outlined in Task 0.3.2. The Contractor may propose subsets of the RPAC to contribute to projects, thereby eliminating the need for every RPAC member to participate in every teleconference and meeting. This proposed RPAC organization shall be pre-approved in writing by the Commission Contract Manager.

The deliverables are:

- ✓ A list of RPAC members that includes name, company, physical and electronic address, and phone number.
- ✓ A brief written explanation of the RPAC organization. This document will include a delineation of which RPAC members will participate in each specific technical contract element.
- ✓ Letters of acceptance, or other comparable documentation of commitment, for each RPAC member.
- ✓ A concise description of the qualifications and capabilities of each RPAC member.

Key Personnel: None

Task 0.2.4: Document Matching Funds

The objective of this task is to document the match funds for this contract.

- The Contractor need not resubmit match fund documentation if it was provided in the Contractor's proposal and the information submitted is still valid. The Contractor, however, shall assist the Commission Contract Manager to locate this proposal information, upon request.
- In the event match fund sources change during the contract term, Contractor shall immediately notify the Commission Contract Manager for approval.

Documentation of match fund commitments shall be received, reviewed and approved in writing by the Commission Contract Manager before: 1) any PIER funds under this contract are disbursed; and 2) PIER-funded work on technical tasks may begin.

The Contractor shall provide the following information about the match funding to be used to conduct this program:

1. Amount and source of each *cash* match funding, including a contact name, address and telephone number.
2. Description, documented market or book value, and source of each *in-kind* contribution, including a contact name, address and telephone number.
3. If the in-kind contribution is equipment or other tangible or real property, Contractor shall identify its owner and provide a contact name, address and telephone number, and the address where the property is located.
4. Written commitment from each source of cash match funding or in-kind contributions that these funds or contributions have been secured or will be secured prior to the date(s) when the funds or in-kind contributions are required for program expenditures.

In the event the Contractor has not provided the written match fund commitments for this program by three months after the contract activation date, the Commission may, at its option and in its unfettered discretion, terminate this agreement by advising Contractor in writing that the contract will be terminated in thirty (30) calendar days.

The deliverables are:

- ✓ Written documentation including amount and source, a contact name, and telephone number for each match funding.
- ✓ Written commitment from each source of cash match funding or in-kind contributions that these funds or contributions have been secured or will be secured prior to the date(s) required for the project implementation.
- ✓ Documentation of changes as they occur.

Key Personnel: None

Task 0.2.5: Identify and Obtain Required Permits

The goal of this task is to list and obtain all permits required for work completed under this contract.

Task 0.2.5a: Identify Required Permits

The Contractor shall:

- Identify permits required for this contract and provide the following information:
 - Type of permit
 - Name, address and telephone number of the permitting jurisdictions or lead agencies
 - Schedule the Contractor will follow in applying for and obtaining these permits
 - Copies of all permits
- Submit this information to the Commission Contract Manager at the first Critical Program Review meeting during the completion of Project 1.1. The schedule of obtaining permits will be discussed at this meeting, and a timetable for submitting updated lists of permits will be developed.
- If no permits are required, the Contractor shall state this finding in writing to the Commission Contract Manager.

The Deliverables are:

- ✓ List of all permits required, or a statement that no permits are required.

Task 0.2.5b: Obtain Required Permits

The Contractor shall:

- Obtain required permits before any specific project-related costs related to the use of the permit(s) are incurred for which PIER reimbursement will be requested under this contract.
- Provide updated list of permits as they change during the contract term.

- Provide documentation of permits as they are approved by the issuing entities during the contract term.

The Deliverables are:

- ✓ Updated list of permits as they change during the contract term.
- ✓ Documentation of permits as they are approved by the issuing entities during the contract term.

Key Personnel: Bill Kitto, Keith Rutledge

Task 0.3: Project Meetings

Task 0.3.1: Critical Project Review Meetings

The objective of this task is for the Commission to discuss with the Contractor the status of the projects and their progress toward achieving their goals and objectives.

Critical project reviews are meetings between the Contractor, the Commission Contract Manager and other individuals selected by the Commission Contract Manager to provide objective, technical support to the Commission. Meeting participants may include PIER Team Lead, Contracts Officer, Commission Technical Staff and Management. These meetings may take place at the Energy Commission offices in Sacramento, or at another, reasonable location determined by the Commission Contract Manager.

Prior to these critical project review meetings, the Contractor shall provide the task deliverable(s) to the Commission Contract Manager in advance to allow the Contract Manager's review of the deliverable document(s). If not already defined in the Work Statement, the Commission Contract Manager shall specify the contents of the deliverable document(s).

At the critical project review meetings, the Contractor shall present the required administrative and technical information, and participate in a discussion about all the projects with the Commission Contract Manager and other meeting attendees.

Following the critical project review meetings, the Commission will determine whether the Contractor is complying satisfactorily with the Work Statement and whether the projects are demonstrating sufficient progress toward their goals and objectives to warrant continued PIER financial support for each project.

The Commission Contract Manager will provide a written response to the Contractor indicating the Commission's conclusions and the direction to be taken as a result of those conclusions, which may include directing the Contractor to not proceed with a specific project, task or to stop work.

The deliverables are:

- ✓ Recommended critical project review schedule deliverable for the kickoff meeting.
- ✓ Critical project review deliverables identified in this work statement or as specified by the Commission Contract Manager.

- ✓ Updated schedule for critical project reviews, provided in the monthly progress reports as necessary.

Task 0.3.2: Renewable Program Advisory Committee Meetings

The objective of this task is for the RPAC to provide strategic guidance to this program by participating in quarterly meetings and/or teleconferences.

The Contractor shall organize and lead all RPAC meetings with the Program Management Team on the following schedule:

Quarterly reviews with the RPAC, 1 or 2 of which each year will be meetings at a location to be determined in consultation with the Commission Contract Manager, and the remainder to be completed via teleconferences.

Exceptions to the above schedule must be pre-approved in writing by the Commission Contract Manager.

The Contractor shall summarize each RPAC meeting or teleconference in writing.

The deliverables are:

- ✓ Suggested RPAC meeting schedule.
- ✓ Draft RPAC meeting agenda(s) with back-up materials for agenda items.
- ✓ Final RPAC meeting agenda(s) with back-up materials for agenda items.
- ✓ Written meeting summaries.

Key Personnel: None

Task 0.4: Annual Technical Briefings

The objective of this project is for the contractor to share the progress and results of the research conducted in the program with *state and national research communities*.

The Contractor shall present at least one technical briefing on the research being conducted in this program during each year of this contract. The Contractor shall provide a written summary of the technical briefing that includes but is not limited to the event and the date, a copy of the presentation (including any handouts that were provided the attendees), the approximate number of attendees, and the results of the presentation (e.g., research products incorporated into a broader scope of work by others).

The deliverables are:

- ✓ A written summary of each technical briefing given by the Contractor on the subject of research conducted within the program.

Key Personnel: Pat Lilly, Bill Kitto, Charles Whitaker, Keith Rutledge

Task 0.5: Reporting

All public reports shall be delivered to:

Accounting Office, MS-2
California Energy Commission
1516 9th Street, 1st Floor
Sacramento, CA 95814

All confidential reports shall be sealed and marked “Confidential Deliverable” and submitted to:

Judith Eghan
Contracts Office, MS-18
California Energy Commission
1516 9th Street, First Floor
Sacramento, CA 95814

Task 0.5.1: Monthly Reports

The objective of this task is to periodically verify that satisfactory and continued progress is being made towards achieving the research objectives of this program.

The Contractor shall submit a Monthly Progress Report to the Commission Contract Manager, starting one month after contract execution and shall continue each following month until the Commission Contract Manager has accepted the Final Report. Attachment 1 provides the format and content requirements for these reports. This format and process shall be used for the monthly reports for the program and for each project.

The Contractor shall maintain a Monthly Highlights Section in the password-protected portion of the Program Management Web Site. The Monthly Highlights Section shall include interim research results (e.g., test data, product mock-ups, field site descriptions, preliminary analyses, draft reports, photographs) necessary to allow the Commission Contract Manager to review contract progress and gauge the quality of research results. They shall also include evidence of software testing as appropriate for software developed or enhanced in this contract. The software test methods shall be discussed and agreed to during the contract kickoff meeting. The Commission Contract Manager will not accept final deliverables nor approve invoices for deliverables without prior review and approval of progress reports and draft deliverables.

The deliverables are:

- ✓ Monthly Progress Reports, for the Program and for each Project, due within 30 days of month's end.
- ✓ Monthly Highlights due within 30 days of month's end.

Task 0.5.2: Year End Reports

The objective of this task is to annually verify that the Commission is receiving the research products expected from this contract. A further objective of this activity is to revise Year 2 & 3 work, if necessary, to incorporate the recommendations of the PAC and of the Commission that will result from the project deliverable and critical program reviews. Attachment 2: Year-end Report Format provides a suggested framework for this report.

The Contractor shall prepare and submit to the Commission Contract Manager a Year End Report for each of the first two years of this contract, describing the original purpose, approach and results of the year's work. This shall include a summary of deviations and corrections to the original research plans. This report shall also include draft research plans with deliverables for the following contract year. These research plans shall incorporate changes in the following year's work plans with deliverables to reflect the results of PAC reviews and the Commission Critical Program and Project Review(s) conducted in the previous year. Year End Reports shall also include updates to the baseline conditions, projected outcomes and performance metrics for each program element.

The deliverables are:

- ✓ Draft Annual Project Reports for each project.
- ✓ Draft Annual Program Report.
- ✓ Final Annual Project for each Project due within 30 days of year-end.
- ✓ Final Annual Program Report due within 30 days of Program year-end.

Key Personnel: None

Task 0.6: Final Reports

The Final Report shall be a public document. If the Contractor has obtained confidential status from the Commission and will be preparing a confidential version of the Final Report as well, the Contractor shall perform the following tasks for both the public and confidential versions of the Final report. Attachment 4 provides the format and content requirements. This format and process shall be used for the final reports for the program and for each project. For the program, this report will be prepared at the end of the entire three-year contract term. **For each project, the final report will be prepared at the conclusion of the project.** The project specific final reports shall address the degree to which the project activities achieved the project goals and objectives, problems encountered in achieving the goals and objectives and recommendation on future work. The overall program final report shall address the degree to which the collection of projects addressed the overall program goals and objectives, problems encountered in achieving the goals and objectives and recommendation on future work.

Task 0.6.1: Final Program Report Outline

The Contractor shall:

- Prepare an outline of the Final Report describing the original purpose, approach and results of the project.
- Submit the final report outline to the Commission Contract Manager for review and acceptance. Once agreement on the outline has been reached, it shall be submitted to the Commission Contract Manager within 5 working days. The Commission Contract Manager shall provide written acceptance within 5 working days of receipt.

The Deliverables are:

- ✓ Draft Final Program Report Outline.

Task 0.6.2: Draft Final Program Report

The Contractor shall:

- Prepare the Draft Final Report for the project. The format of the report shall follow the approved outline.
- Submit the draft final report to the Commission Contract Manager for review and comment. The Commission Contract Manager will provide comments within 20 working days of receipt. If the Commission Contract Manager takes reasonable issue with the format or thoroughness of the draft Final Report, the Contractor and the Commission Contract Manager shall in good faith discuss such issues and the Contractor shall take actions to address the Commission Contract Manager's concerns. Once agreement on the draft final report has been reached, the Commission Contract Manager shall provide written acceptance within 5 working days.

The Deliverables are:

- ✓ Draft Final Program Report.

Task 0.6.3: Final Program Report

The Contractor shall:

Submit the final report within 10 working days of receipt of the acceptance letter. The Contractor shall submit two unbound copies and one electronic copy of the Final Report to the Commission Contract Manager.

The Deliverables are:

- ✓ Final Program Report (2 unbound copies and 1 electronic copy)

Key Personnel: None

Task 0.7: Final Meeting



A final meeting for contract closeout will be attended by, at a minimum, the Contractor and the Commission Contract Manager. The technical and administrative aspects of contract closeout will be discussed at the meeting, which may be two separate meetings at the discretion of the Commission Contract Manager.



The technical portion of the meeting shall present findings, conclusions, and recommended next steps (if any) for the Program. The Commission Contract Manager will determine the appropriate meeting participants.

The administrative portion of the meeting shall be a discussion with the Commission Contract Manager and the Contracts Officer about the following contract closeout items:

- What to do with any state-owned equipment (Options)

- Need to file UCC-1 form re: Commission's interest in patented technology
- Commission's request for specific "generated" data (not already provided in contract deliverables)
- Need to document Contractor's disclosure of "subject inventions" developed under the contract
- "Surviving" contract provisions, such as repayment provisions
- Final invoicing and release of retention

The Deliverables are:

- ✓ Meeting participation/Electronic Presentations
- ✓ Written documentation of meeting agreements and all pertinent information.

Key Personnel: None

Project 0.8 Project-Specific Administrative Tasks

For Each Project:

The Contractor shall:

- Establish the accounting and project tracking system. The Project tracking system shall be compatible with the Commission. Work with the Commission Contract Manager to develop all necessary aspects of the tracking system, including Gantt charts.
- Work with the Commission Contract Manager and the subcontractors to develop an agreed-upon scope of work. The process shall include a review and comment process and final signoff by the Commission Contract Manager.
- Obtain from the subcontractors all necessary financial information, including documentation of rates and fees, equipment and travel.
- Obtain from the subcontractors pre-existing intellectual property and confidential deliverables.
- Finalize the budget and schedule. Work with the subcontractors and the Commission Contract Manager to develop the budgets and prepare them for use in contracts. The schedule shall include Critical Project Review(s) using the pattern for Critical Program Reviews described in Task 0.3.1.
- Establish requirements and procedures for monthly, year-end and final reports and for technical deliverables. All subcontractors shall submit monthly reports, using the format in Attachment 1, which shall be compiled into a monthly report for submission to the Commission. The same is true for the year-end reports, using the format in Attachment 2. Final reports shall be prepared as each project is completed and shall follow the general format in Attachment 4. It is recommended that technical deliverables conform to Attachment 3.
- Develop research-project subcontracts that meet the Commission's contract administration requirements.
- For projects without subcontractors, issue RFPs and obtain subcontractors.

- Prepare, assemble, obtain complete approval for and execute all agreements with subcontractors. If needed, the Contractor will execute confidentiality agreements with the subcontractors. The Contractor shall be responsible for preparing the contracts and ensuring their proper execution.
- Obtain from the subcontractors the required information on permits
- Obtain required permits before any costs related to the use of the permit(s) are incurred for which PIER reimbursement will be requested under this contract.
- Provide updated list of permits as they change during the contract term.
- Provide documentation of permits as they are approved by the issuing entities during the contract term.
- Prepare an initial list of Critical Project Reviews for each project. The list shall identify opportunities to coordinate the reviews among the projects, when schedules and milestones can be coordinated. This list shall be submitted to the Commission Contract Manager within 90 days after the start of the program. It may be updated following the completion of the Program Planning and Analysis Project.
- Conduct kickoff meetings for projects as necessary. The Contractor shall organize all aspects of the kickoff meetings, coordinating times and locations with the Commission Contract Manager. The Contractor shall keep minutes for each meeting and deliver copies of the minutes to the Commission Contract Manager.

The Deliverables are:

- ✓ Fully developed accounting and project tracking systems.
- ✓ Completed work scopes.
- ✓ Completed budgets and schedules.
- ✓ A list of critical project reviews.
- ✓ A schedule of reporting requirements for each project.
- ✓ Fully executed subcontracts from Commonwealth's subcontractors.
- ✓ Issued RFPs (as needed) and completed contracts with subcontractors not listed in this proposal.
- ✓ Permit information as required. [Analysis associated w/ Obtaining Required Permits]
- ✓ Completed project kickoff meetings with deliverables provided to the Commission.
- ✓ List of all permits required, or a statement that no permits are required.
- ✓ Updated list of permits as they change during the contract term.
- ✓ Documentation of permits as they are approved by the issuing entities during the contract term.

Key Personnel: P.Lilly

WORK STATEMENT FOR PROJECT 1.1 - PROGRAM PLANNING AND ANALYSIS

GOALS AND OBJECTIVES

The goals of this project are to develop a formal means of assessing the potential for meeting sub regional needs with local renewable resources for one or two areas within California, and to apply this approach to the development of biogas and solar photovoltaic generation facilities for at least one of these areas. The project will cover assessments of regional energy needs, assessments of biogas and solar resources, and the evaluation of regional grid conditions through power flow modeling.

The objectives of Program Planning and Analysis project are to:

- Determine the most appropriate renewable resources in the region of interest to fully serve the electric distribution grid
- Determine the most appropriate geographic and electric system boundaries of the electric distribution mini-grid
- Assess the technical and market electricity potential of these identified resources within the specified markets in the mini-grid
- Estimate the electric system public benefits of the full development of these renewable resources within the region of interest over the next 5 and 10 years
- Identify candidate sites to participate in the team's RD&D pilot program activities

PROJECTED OUTCOMES

The project will yield four primary products: an assessment of the potential for meeting subregional needs with integrated local renewable resources for up to two areas within California; a preliminary evaluation of the benefits of tailored development, including estimates of generation potential in these areas and in the state as a whole; estimates of economic and environmental benefits; and a detailed plan for developing specific biogas and solar photovoltaic generation facilities in at least one of these areas.

TASK DESCRIPTIONS

Task 1.1.1: Review Previous Statewide/Southern California Renewable Resource Technical and Market Potential Assessments and Define The Transmission/Distribution System Mini-Grid For This Project

The Contractor shall:

Prepare a Review Report which includes available technical and market potential studies of renewable resources and technology, both on a statewide basis and in specifically in Southern California to target the most appropriate resources for this programmatic effort.

Collect information on transmission/distribution system operated by Southern California Edison (SCE), a subsidiary of Edison International, in the greater Chino Basin area. In order to define the

initial geographical boundaries of the proposed mini-grid, data will include one-line drawings of the T&D system overlaid onto geographical maps.

The deliverables are:

- ✓ Assessment Review Report
- ✓ Initially defined Mini-Grid Map

Key Personnel: None

Task 1.1.2: Develop Database of Agricultural Facilities in Southern California, Targeting the Chino Basin

The Contractor shall:

- Collect data on potential available agricultural wastes in Southern California, including livestock and food processing. Database will include data on potential agricultural wastes in Southern California, including livestock and food processing. Characterize the waste including quantity (tons/yr) and quality (heating value and chemical composition). Provide locations of each waste source. For existing dairies include information on dairy electricity and energy loads, manure managements, water use, applicable permits. For existing food processing facilities in Southern CA, supply information on electricity and energy loads, waste production, water use, applicable permits. Prepare an Agricultural Waste in Southern California Database based on the above data.
- Prepare an Agricultural Waste Inventory Report to support the development of technical potential estimates. The report shall contain GIS Maps showing the locations of the agriculture waste.

The deliverables are:

- ✓ a) Agricultural Waste in Southern California Database
- ✓ b) Agricultural Waste GIS Inventory Report.

Key Personnel: None

Task 1.1.3: Inventory Landfill Facilities which Serve as Host for Bioreactor Demonstration Project

The Contractor shall:

Collect data on landfills in Southern California. Characterize the wastes including quantity (tons/yr) and quality (heating value and chemical composition). Provide locations of each landfill. Identify amounts of materials by type and quantities going into landfills, landfill designed capacity and actual capacity, landfill gas production, existing gas recovery methods and amount, existing energy conversion methods.

- Prepare Landfill Database based on the above information.
- Prepare a Landfill Inventory Report which includes:

- Landfill's operating history, expected useful life, and current gas production rates in Chino Basin.
- Sources of feedstock, including location, expected delivery throughput in tons per hour, and institutional issues in Chino Basin.
- Potential energy recovery from landfills both under existing conditions and under a modified operating regime in Chino Basin if energy recovery is to be accelerated using the proposed bioreactor technology
- Initial sizing information and selection criteria for potential landfill facilities, which can serve as host for bioreactor demonstration project. Considerations will include proximity to energy markets, willingness of the landfill operators, and probable cost to the project for utility extensions, etc.
- GIS Maps.

The deliverables are:

- ✓ a) Landfill Database including data on landfills in Southern California.
- ✓ b) Landfill GIS Inventory Report.

Key Personnel: None

Task 1.1.4: Collect Information on Sewage Treatment Plants

The Contractor shall:

- Collect data on sewage treatment plants in the Southern California targeted area with an emphasis on those with existing energy recovery systems using digester gas. Data shall include the size, processes involved, age, and other operational characteristics. Along with this standard gas production/energy recovery system data, additional information about deploying PV systems at these locations will be collected. Collect data to assess the future technical potential of this resource.
- Prepare a Sewage Treatment Plant Database based on the data above.
- Prepare a Sewage Treatment Plant Inventory Report, which describe more detailed information about the wastewater treatment plants in Chino basin, including:
 - Actual gas production rates
 - Current practices involving use of the gas, such as use in power generation, process heating, flaring, etc.
 - Projected growth and development plans, including anticipated gas production plans for replacing processes that may affect gas production and energy needs
 - Opportunities for using waste heat recovery
 - Electrical loads of the plant, interconnection issues, and other such factors that will affect the addition of new generation
 - The age, condition, and operating performance of any generation systems already onsite
 - Permit and other environmental considerations that may affect the plant's operation or future development
 - GIS Map

The deliverables are:

- ✓ a) Southern California target area Sewage Treatment Plant Database
- ✓ b) Sewage Treatment Plant GIS Inventory Report.

Key Personnel: F. Soroushian

Task 1.1.5: Collect information on PV system siting requirements and Identify Potential Candidate Sites for Commercial Photovoltaic Systems

The Contractor shall:

- Collect information on PV system siting requirements and evaluate potential Building Integrated Photovoltaic (BI-PV) sites. A variety of applications such as public sector facilities (including those identified in previous tasks), covered parking, outdoor shelters, building integrated components and PV-direct powering of loads will be combined with financial models including consumer, electricity service provider, and cooperative and third party ownership. The data shall include location and characterization of the resource for the purpose of determining the technical potential.
- Prepare a Commercial BI-PV Systems database that documents the data gathered above.
- Prepare PV Systems Potential Report. The report shall include collected information on PV system siting requirements, conclusions of identified potential BI-PV sites and GIS maps.

The deliverables are:

- ✓ Commercial BI-PV Systems database
- ✓ PV Systems Potential Report

Key Personnel: K. Rutledge

Task 1.1.6: Collect Information on Transmission/Distribution System

The Contractor shall:

- Collect information on transmission/distribution system operated by Southern California Edison (SCE), a subsidiary of Edison International in the Chino area. Set up a meeting with appropriate SCE utility personnel to discuss and obtain appropriate current and planned local subtransmission and distribution system characteristics. These characteristics are expected to include distribution substation transformer size and location, distribution feeder ratings, length and load density. Expected load growth and new facilities planned over the next 5 and 10 years (or other horizon year) and installed cost data will be obtained if available. Other appropriate distribution planning and design criteria will be obtained. Customer load models, load shape data and coincidence factors for local residential, commercial and industrial loads will also be gathered.
- Prepare a T&D System Database based on the above information.

The deliverables are:

- ✓ T&D System Database

Key Personnel: None

Critical Project Review Meeting

Task 1.1.7: Assess Electricity Market Potential (MW's) of biogas and commercial PV within the mini-grid region

The Contractor shall:

- Estimate the market potential for biogas and commercial PV within the mini-grid region. The location and relative generating capacity of potential generating resources, developed in previous tasks, will be segmented by geographic proximity to the bulk transmission and local distribution system of the selected mini-grid. Resources will be categorized relative to their potential transmission impacts into one of four categories:
 1. Potential power resources that can be readily accommodated or have beneficial impacts on transmission loadings.
 2. Potential power resources that, because of their nature, are not likely to have a direct impact on transmission loadings.
 3. Power resources that cannot be immediately handled but which are sufficiently close to load centers to consider upgrading transmission lines or building new transmission lines.
 4. Power resources that are too remote and well beyond other resources that are more likely to be considered for transmission upgrades.

This categorization will be performed both for the proposed program facilities and for a fully realized mini-grid market potential. Figure 1.1-1 illustrates how this capacity information can be categorized.

- Prepare Electricity Market Potential for the Mini-Grid Region Report based on the categories above.

The deliverables are:

- ✓ Electricity Market Potential for the Mini-Grid Region Report

Key Personnel: P. Lilly

Figure 1.1-1: Market Potential Capacity

	PROGRAM FACILITIES CAPACITY (MW)					MINI-GRID CAPACITY (MW)				
	Local Distribution Systems					Local Distribution Systems				
	"A"	"B"	"C"	etc	Total	"A"	"B"	"C"	etc	Total
BioGas										
Proximity Category 1										
Proximity Category 2										
Proximity Category 3										
Proximity Category 4										
Total										
PV Solar										
Proximity Category 1										
Proximity Category 2										
Proximity Category 3										
Proximity Category 4										
Total										
Total										
Proximity Category 1										
Proximity Category 2										
Proximity Category 3										
Proximity Category 4										
Total										

Task 1.1.8: Develop generation profiles of the combined biogas resources and PV based upon 1) proposed program; and 2) fully realized mini-grid market potential

Matching the generation and the demands for electricity requires knowledge of both the generation profiles of the facilities providing the electricity and the demand profiles of the customers utilizing the electricity. Transmission constraints on the ability of the generating resources to meet the demand needs are a function of the physical location, relative to the available transmission/distribution system, of the generating resources to the demand needs.

Generation profiles vary by time of day, season of the year, and by type of energy resource. Some of the biogas resources may be capable of providing base load, intermediate, and potentially some peaking generating profiles. PV resources may include battery backup capability – if required by the end-user.

The Contractor shall:

- Develop profiles for each type of the biogas and PV resource, along with an assessment of the flexibility of each generating profile based upon 1) proposed program; and 2) fully realized mini-grid market potential.

The deliverables are:

- ✓ Generation profiles for each type of biogas and PV resource.

Key Personnel: None

Task 1.1.9: Conduct Power Flow Analysis within Mini-Grid

Develop Local Area T&D Model

The Contractor shall:

- Develop an appropriate local area transmission, subtransmission and distribution (T&D) model representing the Chino area, or other selected southern California suburban area mini-grid. The mini-grid is expected to contain a mixture of overhead and underground construction and a medium load density level. The distribution circuits are expected to be radial. However, the distribution system will likely be designed to provide manual switching to adjacent feeders in the event of an outage. The local subtransmission and bulk transmission facilities are expected to provide for N minus 1 contingencies.
- Develop local area distribution mini-grid model at peak and light load conditions for 5 and 10 years (or other selected horizon year) without adding the distributed biogas and PV renewable resources (DR), using the best available data.

Develop Matrix of Distributed Resources Cases

The Contractor shall:

- Develop a matrix of cases to evaluate potential T&D impacts for a range of penetration level and mix of DR. Currently, appropriate power quality and reliability are attained through the application of distribution standards and operating procedures. The objective of the power flow study is to perform appropriate power flow evaluations with DR to maintain similar or upgraded levels of distribution system or customer service reliability with DR installed.
- Extend the analysis to the local subtransmission level where appropriate, as previous experience indicates that subtransmission facilities serving a distribution system can also be affected by the DR penetration levels to be assessed in this project. The matrix of cases will incorporate a range of expected penetration levels for the alternative DR technologies 5 and 10 years (or other selected horizon year) into the future.

Evaluate T&D System Impacts

The matrix of cases to be evaluated shall be developed during the course of the project.

However, the following types of T&D system issues shall be addressed:

- Power flows and losses during system peak and light loading conditions.
- Voltage control, regulation and VAR supply.
- T&D system and customer service reliability.
- Impact of reverse power flow on distribution system equipment.
- Potential voltage flicker problems.

The Contractor shall:

- Use the General Electric (GE) Power Systems Load Flow (PSLF) program to make the steady state T&D system power flow, voltage and VAR calculations. The program will allow the detailed power flow modeling of the distribution system, including the distribution substation transformers, three phase feeders and laterals, as well as appropriate modeling of subtransmission and transmission system serving the local distribution mini-grid. If necessary, the Contractor will also model the single phase distribution primary and secondary systems.

- Evaluate the initial set of 4 – 5 DR cases under both peak and light load conditions with the DR penetration levels varied as described above. The initial set of cases will explore the T&D system impacts when the 4 – 5 alternative DR mixes and DR penetration levels are employed. Impacts on T&D facility loading, losses, voltage and VAR requirements will be identified during peak and off-peak conditions.
- After reviewing the first set of case results, another set of 4 – 5 appropriate sensitivity cases will also be defined and evaluated to explore the relative T&D impacts for some of the following:
 - Different mixes of DR.
 - When the DR is installed at different locations in the distribution mini-grid.
 - Different DR penetration levels and mix.
 - Supply upgraded T&D reliability.

Determine Potential Renewable Resource Development T&D Value

For the matrix of DR cases resulting site-specific T&D system impacts will then be used to determine:

- Local transmission, subtransmission and distribution facility deferrals using appropriate T&D and customer service reliability and planning criteria.
- Annual loss reduction in the local T&D system.
- Power quality benefits (or penalties) such as T&D voltage control and power factor correction requirements.

The Contractor shall:

- Calculate the Annual T&D value in the two future study years using appropriate T&D facility capital investments, and cost of losses assumptions. Present worth of these annual T&D value data will then be determined using appropriate financial assumptions determined after project initiation.

Technical Reviews

The Contractor shall:

Prepare for and make presentations at two one-day technical reviews during the course of performing this task. One technical review is assumed to be in Sacramento and one technical review is assumed to be in southern California.

The deliverables are:

- ✓ a) Local area T&D Model
- ✓ b) Summary Report and detail reports that documents all pertinent studies included in this task.
- ✓ c) Two one-day technical reviews

Key Sub/Personnel: ZECO/H. Zaininger

Task 1.1.10: Prepare Prioritized List of Pilot Projects for PV and Biogas Systems

The Contractor shall:

- Analyze and prioritize the pilot projects by assembling the top three projects in each of three biogas categories: 1) livestock operations, 2) landfill/bioreactor facilities, and 3) sewage treatment plants. Prioritize the top 10 PV projects. Prioritization shall be based on 1) renewable resource availability, 2) linkages to other projects, 3) the potential for economic development, 4) environmental considerations, and 5) impact on the mini-grid's transmission distribution system.
- Prepare a table listing the top nine biogas projects and the top ten PV projects. This table shall include descriptive information about the project's emphasis areas and summary information about the resource availability, cost, environmental considerations, and effects on the mini-grid. This table shall be included in the report for this project.

The deliverables are:

- ✓ List of top 9 biogas projects and top 10 PV projects and analysis supporting Project prioritization.

Key Personnel: None

Task 1.1.11: Prepare Final Report for Project 1.1

The Contractor shall:

- Prepare a Biogas and Building Integrated Photovoltaics (BI-PV) Pilot Plant Development Report that will include the following elements:
 - Introduction
 - Summary of Biogas Resource Inventory
 - Livestock Waste Resource
 - Landfill Gas Bioreactor Resource
 - Sewage Treatment Biogas Resource
 - Summary of PV Resource Potential and Candidate Sites
 - Document the market potential
 - Document power flow analysis and results
 - Prioritized List of Linked PV and Biogas systems
 - Description of Pilot Facilities Development Scenario
 - Process to Develop Scenario (based on individual project parameters and mini-grid analysis)
 - Detailed Description of Scenarios (including size, location, cost, and anticipated development sequence)
 - Recommended Scenarios (including rationale for selection)
 - Results that may be applicable to future projects (including a summary of findings and lessons learned that will be passed on to future developers of biogas projects).

- Submit the draft report in accordance with the process described for reports that will be discussed at a Critical Project Review in Attachment 3.

The deliverables are:

- ✓ a) Outline of the Final Report for Project 1.1
- ✓ b) Draft Biogas and Building Integrated Photovoltaics (BI-PV) Pilot Facilities Development Report
- ✓ c) Final Biogas and Building Integrated Photovoltaics (BI-PV) Pilot Facilities Development Report

Key Subs/Personnel: RER/CH2M Hill (P. LillyB. Kitto)

Critical Program Review Meeting

Task 1.1.12: Coordination with Renewable Project Advisory Committee

Committee representatives shall be briefed before the beginning of this project and a coordination meeting shall be held at the end of Task 1.1.5. A draft of the summary report prepared in Task 1.1.11 shall be reviewed with the Committee before it is finalized and distributed to the Commission and other interested parties.

The deliverables are:

- ✓ None.

Task 1.1.13: Preparation of Measurement and Evaluation Plan

The Contractor shall:

- Prepare a comprehensive Program measurement and evaluation (M&E) Plan. This plan shall be used to evaluate each of the specific projects and each project's contribution to the overall Commonwealth Program-level goals and objectives.

For each Project:

- Assist in defining the specific performance metrics, data collection plans and analysis techniques.
- Discuss how the Program M&E plan will be integrated with the project implementation schedule.

The project-specific evaluation plans shall include at minimum three sections for each project: 1) Pilot Performance, 2) Technology Transfer and 3) Market Impact.

For the Program:

- Define the specific performance metrics, data collection plans, analysis techniques, and the M&E implementation schedule.
- Determine the degree to which each of the funded projects contributed to the stated goals and objectives of the Program.

- Address the effectiveness of the programmatic aspects (linkages) between the projects in the Commonwealth Program in achieving their goals, as well as any linkages to the other PIER-funded Renewables Programs that are being implemented over the same time frame.

This plan shall define, for the Program-level and the distinct project objectives, specific performance metrics, data collection plans, analysis techniques, and the M&E implementation schedule. The overall Program-Level M&E Plan shall be structured in a fashion to determine the degree to which each of the funded projects contributed to the stated goals and objectives of the Program. In addition, the Plan shall also address the effectiveness of the programmatic aspects (linkages) between the projects in the Commonwealth Program in achieving their goals, as well as any linkages to the other PIER-funded Renewables Programs that are being implemented over the same time frame.

The following **project-specific** evaluation aspects shall be considered in the M&E Plan by the RER Evaluation Team as identified below for each of the approved projects:

Project 2.1: Enhanced Landfill Gas Using Bioreactors Project. This M&E element shall include three sets of issues:

Pilot Performance. The Contractor shall evaluate the environmental, engineering, and economic performance of the pilot projects using the criteria delineated in Table 2.1-1 and Table 2.1-2. Environmental performance will be measured by comparing the potential environmental benefits of capturing all the methane potential, the existing conditions and the benefits associated with the two reactors considered in this program. Economic and engineering information will be presented in a similar format.

Technology Transfer. RER will assess the extent to which the advancements accomplished at the pilot site were transferred to other team members as well as to others in the renewables community. Part of this assessment will address the effectiveness with which the project team worked with the RPAC.

Market Impact. RER will also assess the likely impacts of the advancements stemming from the project on market acceptance of landfill gas in the mini-grid area(s) as well as in the state as a whole. This assessment will be based upon an assessment of the relative cost-effectiveness of the demonstrated technology relative to conventional technologies, as well as the extent to which it mitigates some of the non-cost barriers to market acceptance.

Table 2.1-1 Environmental Benefits

Environmental Benefits	Potential (Assuming All Methane Is Recovered)	Existing Situation	Situation With Bioreactor 1 (MSW Only)	Situation With Bioreactor 2 (MSW Supplemented With Animal Or Food Waste)
Methane production (ton/year)				
CO ₂ equivalent of CH ₄ reduction (ton/year)				
CO ₂ emissions avoided by generation displacement (ton/year)				
Coal				
Fuel oil				
Natural Gas				
NO _x emissions avoided by generation displacement (ton/year)				
Coal				
Fuel oil				
Natural Gas				
Other				
SO ₂ emissions avoided by fuel displacement (ton/year)				
Coal				
Fuel oil				
Natural Gas				
Other				

Table 2.1-2 Engineering and Economic Costs

Engineering/Economic Consideration	Existing	With Bioreactor 1 (MSW Only)	With Bioreactor 2 (MSW Supplemented With Animal Or Food Waste)
Electricity Production			
Total capacity (MW)			
Average annual output (\$)			
Capital Cost (\$)			
Annual O&M (\$/year)			
Environmental Benefits (\$)			
Total Life Cycle Cost (\$)			
Rate of Return (percent)			

Project 2.2: Enhanced Energy Recovery through Use of Microturbines and Optimization of Anaerobic Digestion Project. This M&E Plan element will focus on three sets of issues:

Pilot Performance. The Contractor will evaluate the performance of the effectiveness of enhancing energy recovery at the host facilities, as indicated by the specific performance metrics. The primary emphasis here will be on the increased output of energy, the effects on cost-effectiveness, and the environmental impacts relative to conventional approaches. Data on these aspects of performance will have been collected and analyzed by the project team under Task 2.2.5, and these results will be further assessed.

Technology Transfer. RER will assess the extent to which the advancements accomplished at the host facilities were transferred to other team members as well as to others in the renewables community. Part of this assessment will address the effectiveness with which the project team worked with the RPAC.

Market Impact. RER will also assess the likely impacts of the advancements stemming from the project on market acceptance of wastewater gas generation in the mini-grid area(s) as well as in the state as a whole. This assessment will be based upon an assessment of the relative cost-effectiveness of the demonstrated technology relative to conventional technologies, as well as the extent to which it mitigates some of the non-cost barriers to market acceptance.

Project 3.1 Dairy Waste to Energy Project. This M&E Plan element will focus on the same three sets of issues:

Pilot Performance. The Contractor will evaluate the performance of the effectiveness of enhancing energy recovery at the host facilities, as indicated by the specific performance metrics listed and developed under Task 3.1.6. The primary emphasis here will be on the increased output of energy, the effects of program advancements on cost-effectiveness, and the environmental impacts relative to conventional approaches.

Technology Transfer. RER will assess the extent to which the advancements accomplished at the host facilities were transferred to other team members as well as to others in the renewable energy community. Part of this assessment will address the effectiveness with which the project team has worked with the RPAC.

Market Impact. RER will also assess the likely impacts of the advancements stemming from the project on market acceptance of dairy waste generation in the mini-grid area(s) as well as in the state as a whole. This assessment will be based upon an assessment of the relative cost-effectiveness of the demonstrated technology relative to conventional technologies, as well as the extent to which it mitigates some of the non-cost barriers to market acceptance.

Project 3.2 Building Integrated PV Testing and Evaluation Project. This Project M&E Plan will focus on the following BI-PV systems issues:

- System selection criteria (scale up, eligible for buy down/Self-Generation Program)
- System performance and reliability testing criteria
- Technology Transfer Effectiveness

Selection Criteria. The focus of the selection criteria will be commercial building-integrated PV systems relevant to the Commonwealth Biogas PV Renewable Energy Affordability RD & D Program and the California Energy Commission PIER program. Up to three sample PV systems will be purchased and evaluated. Selection of sample systems will be based on such factors as:

- Relevance of the system to other activities within the program, such as a forthcoming procurement
- Relevance of the system to the California CEC/CPUC PV Buydown Programs
- Availability of prior testing data and system changes made since prior evaluation(s)
- Key system components that have not been previously evaluated
- Information from other sources, such as our verification monitoring and troubleshooting work with the Commission's Emerging Buydown Program systems

Pilot Performance. While the major components are being evaluated, the Contractor shall review the documentation for code compliance, installation issues, ease of installation, quality of design, etc. The evaluation plan shall encompass the operational performance of the testing facility, the reported usefulness of the results to potential users (including key Commonwealth Team members), and the effectiveness with which the project team worked with the RPAC.

Technology Transfer. The RER evaluation plan will assess the extent to which the learnings and system advancements accomplished at the BI-PV pilot test facilities were effectively transferred to the Commonwealth team members and to other key participants in the PV supply channel and development community. Another aspect of this assessment will address the effectiveness with which the project team worked with the RPAC and other PIER Renewables Program teams.

Market Impact. Outside of the PIER Program Team's use of the Pilot plant results, there are no direct market impacts expected from this performance testing project.

Project 3.3: Building Integrated PV on Public Facilities Project. This M&E Plan component will focus on the same three sets of issues:

Pilot Performance. The Contractor will evaluate the environmental, economic, and engineering performances of the Building Integrated PV on Public Facilities Project, and monitoring data developed under Task 3.3.4c. The primary emphasis here will be on the output of energy, the effects of program advancements on cost-effectiveness, and the environmental impacts relative to conventional approaches.

The environmental performance will be measured by comparing the potential environmental benefits of producing electricity from environmentally sound photovoltaic technology. Performance information will be collected and presented for the environmental measures shown in Table 3.3-1 below. The Economic and engineering information will be presented in a similar format as shown in Table 3.3-2.

Technology Transfer. RER will assess the extent to which the advancements accomplished at the host facilities were transferred to other team members as well as to others in the renewables community. Part of this assessment will address the effectiveness with which the project team worked with the RPAC.

Market Impact. RER will also assess the likely impacts of the advancements stemming from the project on market acceptance of both integrated biogas and PV generation in the mini-grid area(s) as well as in the state as a whole. This assessment will be based upon an assessment of the relative cost-effectiveness of the integrated approach relative to conventional approach of independent development, as well as the extent to which it mitigates some of the non-cost barriers to market acceptance.

Table 3.3-1: Environmental Benefits

Environmental Benefits	Potential (Assuming Design Specifications)	Existing Situation	Situation With BIPV
Electricity Production (kWh/year)			
CO ₂ equivalent of kWh reduction (ton/Year)			
CO ₂ emissions avoided by fuel displacement (ton/year)			
Coal			
Fuel Oil			
Natural Gas			
No _x emissions avoided by fuel displacement (ton/year)			
Coal			
Fuel Oil			
Natural Gas			
Other			
SO ₂ emissions avoided by fuel displacement (ton/year)			
Coal			
Fuel Oil			
Natural Gas			
Other			

Table3.3-2: Engineering and Economic Metrics

Engineering/Economic Consideration	Existing	With BIPV
Electricity Consumption		
Total Capacity (MW)		
Avg. Annual Cost (\$)		
Capital Cost (\$)		
Annual O & M (\$/year)		
Environmental Benefits (\$)		
Total Life Cycle Cost (\$)		
Rate of Return (percent)		

The deliverables are:

- ✓ Draft and Final M&E Plan for project 3.2.
- ✓ Draft and Final M&E Plan for the overall Program and for each approved and scheduled project.

Key Personnel: F. Sebold

WORK STATEMENT FOR PROJECT 2.1 - ENHANCED LANDFILL GAS PRODUCTION USING BIOREACTORS

GOALS AND OBJECTIVES

The goals of Enhanced Landfill Gas Production Using Bioreactors project are to:

- Advance the state of knowledge for using bioreactors at landfills to increase landfill gas production and improve the characteristics of the waste to accelerate reclamation
- Work with environmental regulators to develop and implement a strategy for developing bioreactors while meeting applicable groundwater and other environmental standards
- Establish the economic and environmental benefits of the use of landfill bioreactors

The objectives of this project are to:

- Develop a conceptual design for two types of landfill bioreactors
 - MSW or organic waste landfill bioreactor (First Bioreactor)
 - MSW or organic waste landfill bioreactor supplemented by food or animal waste (Second Bioreactor)
- Develop environmental documentation to satisfy regulators
- Quantify greenhouse gas and pollution reduction benefits
- Develop two types of landfill bioreactors
 - MSW or organic waste landfill bioreactor (First Bioreactor)
 - MSW or organic waste landfill bioreactor supplemented by food or animal waste (Second Bioreactor)

PROJECTED OUTCOMES

The outcome of this project will be the successful operation of two bioreactor pilot projects. One bioreactor will be designed to use municipal solid waste (MSW) and source-separated organic waste materials; the other will be designed to use MSW or source-separated organic waste materials along with animal waste. Performance metrics will include measurement of changes in methane production; estimation of direct reductions in CH₄ emissions and indirect reductions in other criteria air emissions associated with displaced conventional generation; and assessment of changes in lifecycle costs of generation from landfill gas. It is anticipated that the cumulative incremental gas production from both of these pilot reactors will be in the range of 1 to 5 MW.

In addition to demonstrating the feasibility of developing these bioreactors, two reports will be developed. One report will summarize the regulatory issues that were addressed and satisfied in the course of developing this project. This report will include guidelines to be used on future projects and a methodology for calculating the economic value of environmental benefits of the project. The second report will summarize the engineering work done to design and install the reactor and present pertinent installation, operation, and maintenance costs. Project lifecycle costs will be presented incorporating engineering issues as well as the value of environmental benefits presented in the first report.

TASK DESCRIPTIONS

Task 2.1.1a: Characterize MSW and Source Separated Organic Waste to Be Placed in Both Bioreactors

The Contractor shall:

- Prepare a Landfill Feedstock Characterization Report. This report will characterize biodegradable organics, non-biodegradable organics, inorganic wastes, moisture content, C/N ratio of the wastes added to landfills, and describes physical and operating parameters of landfills evaluated.

The deliverables are:

- ✓ Landfill Feedstock Characterization Report

Key Sub/Personnel: CH2M Hill/Chuck Kemper

Task 2.1.1b: Characterize Food or Animal Wastes to be Placed as Amendment in the Second Bioreactor

The Contractor shall:

- Prepare a Landfill Amendment Characterization Report. This report will characterize biodegradable organics, non-biodegradable organics, and inorganic wastes in amendment to be added to waste. The quantity, physical and chemical characteristics of the waste shall be analyzed for its suitability to serve as an amendment to the MSW bioreactor. Characteristics to be quantified include weight, volume, moisture content, heating value, and chemical constituents. The Report shall also describe physical and operating parameters of collection processes identifying components of waste that can affect bioreactor performance.

The deliverables are:

- ✓ Landfill Amendment Characterization Report

Key Sub/Personnel: CH2M Hill/Chuck Kemper

Task 2.1.2: Identify Amendment Source Locations for the Second Bioreactor

The Contractor shall:

Identify the Locations of the Top Five Amendment Sources. Prepare an Amendment Source Location List. These locations shall be identified on a map. Each site identified will have waste characterization information collected in tasks 2.1.1.a and 2.1.1.b.

The deliverables are:

- ✓ Amendment Source Location List

Key Sub/Personnel: CH2M Hill/Chuck Kemper

Task 2.1.3a: Prepare Conceptual Design for the First Bioreactor

The Contractor shall:

- Select the location for the first bioreactor.

- Design the size of the bioreactor to optimally produce gas while meeting environmental requirements. As part of this design effort, heat and material balances, process and instrumentation diagrams, and detailed design drawings will be prepared. The energy recovery component of this pilot plant will include a low-emitting engine generator set or small turbine generator system. It will be designed to meet all applicable environmental requirements. The balance of plant facilities including electrical interconnection equipment, water, or other cooling system, and any other necessary support facilities will be included. All drawings and specifications needed for construction will be prepared.
- Prepare a Conceptual Design Report for the First Bioreactor. This Report shall fully document the work in this task including design assumptions, calculations of the time until biodegradation is complete on all the waste and a bioreactor closure plan.

The deliverables are:

- ✓ Energy and Material Balance. Process and Instrumentation Diagrams, and Detailed Design Drawings.
- ✓ Conceptual Design Report for the First Bioreactor.

Key Sub/Personnel: CH2M Hill/Chuck Kemper

Task 2.1.3b: Prepare Test and Construction Plans for the First Bioreactor

The Contractor shall:

- Prepare test and construction plans including:
 - Bioreactor test plan in accordance with the guidelines in Attachment 3. The test plan shall be prepared in coordination with the M&E plan described in Task 1.1.13.
 - Final Construction Plans and Specifications for the First Bioreactor.
 - Liner Installation Plan for the First Bioreactor to assure that liner materials are properly placed.
 - Analysis needed for applicable permits.

The deliverables are:

- ✓ First Bioreactor Test Plan.
- ✓ Final Construction Plan.
- ✓ Liner Installation Plan.

Key Sub/Personnel: CH2M Hill/Chuck Kemper

Task 2.1.3c: Prepare Conceptual Design for the Second Bioreactor

The Contractor shall:

- Select the location for the second bioreactor.
- Design the size of the bioreactor to optimally produce gas while meeting environmental requirements. As part of this design effort, heat and material balances, process and instrumentation diagrams, and detailed design drawings will be prepared. The energy recovery component of this pilot plant will include a low-emitting engine generator set or

small turbine generator system. It will be designed to meet all applicable environmental requirements. The balance of plant facilities including electrical interconnection equipment, water, or other cooling system, and any other necessary support facilities will be included. All drawings and specifications needed for construction will be prepared.

- Prepare a Conceptual Design Report for the Second Bioreactor. This Report shall fully document the work in this task including design assumptions, calculations of the time until biodegradation is complete on all the waste and a bioreactor closure plan.
- Prepare Groundwater Contamination Risk Report to assess the potential contamination due to the addition of animal waste into the landfills.

The deliverables are:

- ✓ Draft Conceptual Design Report for the Second Bioreactor
- ✓ Final Conceptual Design Report for the Second Bioreactor
- ✓ Groundwater Contamination Risk Report

Key Sub/Personnel: CH2M Hill/Chuck Kemper

Critical Project Review Meeting

Task 2.1.3d: Prepare Test and Construction Plans for the Second Bioreactor

The Contractor shall:

- Prepare test and construction plans including:
 - Bioreactor test plan in accordance with the guidelines in Attachment 3. The test plan shall be prepared in coordination with the M&E plan described in Task 1.1.13.
 - Final Construction Plans and Specifications for the First Bioreactor.
 - Liner Installation Plan for the First Bioreactor to assure that liner materials are properly placed.

The deliverables are:

- ✓ Second Bioreactor Test Plan.
- ✓ Final Construction Plan.
- ✓ Liner Installation Plan.

Key Sub/Personnel: CH2M Hill/Chuck Kemper

Task 2.1.4a: Construct and Operate the First Bioreactor

The Contractor shall:

- Construct the First Bioreactor. Construction will involve three elements. First is the construction of the reactor itself. It is assumed this will take advantage of existing landfill cells, but that the leachate system will need to be modified to allow for recirculating the water. The gas collection system will also need to be modified to accommodate the higher production levels. The second component of the project will be the energy recovery system. This system will consist of a low-emitting engine generator or small turbine system. The

system will be installed on a concrete pad or other permanent facility for its long-term operation. All environmental requirements will be satisfied. The third component involves the electrical gear associated with interconnection with the existing transmission/distribution system. All control and protection systems will be installed in accordance with local codes and interconnection agreement requirements.

- Prepare Notification Letter the completion of the First Bioreactor. The letter shall state that the first bioreactor has been completed, the liner and electrical gear installed, and the energy recovery system has been constructed.
- Operate the first Bioreactor for six months so that operating and performance experience can be gained and information collected on its performance and operating costs in accordance with the approved test plan. A Six-Month Operations Report for the First Bioreactor will be submitted at the end of this period.

The deliverables are:

- ✓ 1) Notification Letter for completion of the Installing Liner. Documentation that liners are installed including pictures, notification letter, and applicable permits.
- ✓ 2) Notification Letter for completion of the Leachate Collection System. Documentation that leachate collection systems are installed including pictures, notification letter, and applicable permits.
- ✓ 3). Notification Letter for completion of the Gas Collection System. Documentation that gas collection systems are installed including pictures, notification letter, and applicable permits.
- ✓ 4). Notification Letter for completion of Energy Recovery and Prime Mover Systems. Documentation that energy recovery and prime mover has been installed including pictures, notification letter, applicable permits.
- ✓ 5). Notification Letter for completion of the Interconnection hardware. Documentation that interconnection hardware has been installed including pictures, notification letter, applicable permits and applicable interconnection agreements.
- ✓ 6). Six Month Operations Report for the First Bioreactor

Key Sub/Personnel: CH2M Hill/Chuck Kemper

Task 2.1.4b: Construct and Operate the Second Bioreactor

The Contractor shall:

- Construct and operate the Second Bioreactor in a manner similar to that in Task 2.1.4a.

The deliverables are:

- ✓ 1) Notification Letter the completion of the installing liner. Documentation that liners are installed including pictures, notification letter, and applicable permits.
- ✓ 2) Notification Letter for completion of the Leachate Collection System. Documentation that leachate collection systems are installed including pictures, notification letter, and applicable permits.
- ✓ 3) Notification Letter for completion of the Gas Collection System. Documentation that gas collection systems are installed including pictures, notification letter, and applicable permits.

- ✓ 4) Notification Letter for completion of Energy Recovery and Prime Mover Systems. Documentation that energy recovery and prime mover has been installed including pictures, notification letter, applicable permits
- ✓ 5) Notification Letter for completion of the Interconnection hardware. Documentation that interconnection hardware has been installed including pictures, notification letter, applicable permits and applicable interconnection agreements.
- ✓ 6) Six Month Operations Report for the Second Bioreactor

Key Sub/Personnel: CH2M Hill/Chuck Kemper

Task 2.1.5: Prepare Final Report for Project 2.1

The Contractor shall:

Prepare the Enhanced Landfill Gas Production Using Bioreactors Report. This report shall include sections on Landfill Regulatory Issues, engineering and economics.

- The section addressing the regulatory issues will describe in detail the environmental studies conducted. Projected impacts, adopted mitigation measures, and monitoring requirements will be described. Particular emphasis will be given to describing the commitments made in order to obtain regulatory approval for the project. This environmental report will also include a set of guidelines intended to assist developers of future similar projects. This will be a “lessons learned” manual that will enable future bioreactor developers to have their facilities constructed more rapidly.
- The section on engineering and economics will document the basis of design and the design standards that can be readily transferred to other future similar facilities. A key aspect of the economic analysis that will be a part of this final report will be a description of the methodology for calculating the economic value of environmental benefits on these projects. Project lifecycle costs will be presented incorporating engineering issues as well as the value of environmental benefits.
- Submit the report in accordance with the process described for reports in Attachment 4.

The deliverables are:

- ✓ a) Outline of the Final Report for Project 2.1.
- ✓ b) Draft Enhanced Landfill Gas Production Using Bioreactors Report.
- ✓ c) Final Enhanced Landfill Gas Production Using Bioreactors Report (Submit Final Report to CEC and RPAC).

Key Sub/Personnel: CH2M Hill/Chuck Kemper

Task 2.1.6: Coordinate with Renewables Project Advisory Committees

The Contractor shall:

- Brief the Committee representatives at the beginning of this project and midway through Task 2.1.3a. A draft of the summary report prepared in Task 2.1.5 shall be reviewed with the

Committee before it is finalized and distributed to the Commission and other interested parties.

The deliverables are:

- ✓ None

Task 2.1.7: Evaluate Project

The Contractor shall:

- Evaluate this project in accordance with the M&E plan (Task 1.1.13).
- Evaluation of the Project's achieved technical objectives and its contribution to the Program's stated objectives.
- Prepare the Enhanced Landfill Gas Using Bioreactors Project Evaluation Report.

The deliverables are:

- ✓ a). Draft Enhanced Landfill Gas Using Bioreactors Project Evaluation Report
- ✓ b). Final Enhanced Landfill Gas Using Bioreactors Project Evaluation Report

Key Sub: RER

**WORK STATEMENT FOR PROJECT 2.2 - ENHANCED ENERGY RECOVERY
THROUGH OPTIMIZATION OF ANAEROBIC DIGESTION AND MICROTURBINES**

GOALS AND OBJECTIVES

The objectives of Enhanced Energy Recovery through Optimization of Anaerobic Digestion and Microturbines project are to:

- Increase and optimize digester gas production through thermal hydrolysis and ultrasound processes
- Develop and optimize cost effective gas cleanup systems
- Evaluate and quantify environmental benefits that result from using microturbines at sewage treatment plants
- Evaluate performance and cost during operation so sewage treatment plants have greater certainty on cost and reliability of using microturbines

PROJECTED OUTCOMES

The first outcome will be to develop and optimize gas cleanup systems. At least three gas cleaning systems will be defined and optimized. It is anticipated that one of these systems will involve hydrogen sulfide removal, gas drying, and siloxane removal. A second system will likely involve gas drying and siloxane removal. A third system, with parameters not yet defined, will

also be formulated. The installed and operating cost for each of these systems will be determined for the full project lifecycle.

A detailed evaluation and quantification of environmental benefits for each of the systems described above will also be developed. These will be presented in the context of the Capstone microturbine. A comparison to the existing conditions will be included in this assessment. The expected outcome will be to increase gas production by 10 to 20% at an existing wastewater treatment plant, which ranges in size from 1 to 50 gpm. Also on this project, the Contractor will seek to improve the efficiency and cost-effectiveness of gas cleaning systems used on micro turbines, but in this part of the project it may make more sense to test the work at an existing facility rather than install new generation. The expected cumulative generating capacities resulting from this project is expected to range from 60kW to 1 MW.

The results of this work will be documented in a report that evaluates the cost and effectiveness of the various gas cleanup systems for each of the microturbines considered. The economics of the systems will be evaluated based on the value of electricity produced and waste heat recovered and used at the sewage treatment plant. Various alternatives will be compared by examining the net present value of different systems and the rate of return based on funds utilized.

For the digester gas production improvement processes (thermal hydrolysis and ultrasound), the focus will be on evaluation of the systems, their impact on gas production, and their cost effectiveness. An evaluation of the digester gas production and quality as well as biosolids reduction rate and dewatering characteristics will be presented. The installation and operating costs for the systems will be established for full-scale facilities. The cost-effectiveness evaluation will include the overall installation and operating cost compared to the benefits of improved gas production and reduces biosolids mass for disposal/reuse. A detailed evaluation and quantification of environmental benefits for each of the systems will also be developed.

TASK DESCRIPTIONS

Task 2.2.1: Process Selection.

The Contractor shall:

- Evaluate and select two sets of processes that are potentially employed at the sites identified in project 1.1. The first set of processes to be selected includes gas cleaning systems for microturbines defined above. Three gas cleaning processes that involve different technologies for hydrogen sulfide removal, gas drying and compression, and siloxane removal will be selected. The second set of processes to be selected relates to optimization of anaerobic digestion gas production. The digester gas production improvement processes through application thermal hydrolysis and ultrasound pretreatment will be evaluated.
- Prepare Gas Cleaning Systems for Microturbines and Optimization of Anaerobic Digestion Gas Production Selection Reports.

The Gas Cleaning Systems for Microturbines Selection Report shall include the descriptions of the technologies, including process flow diagram, involved in three gas cleaning processes. The report shall also include cost estimates of the three gas cleaning processes for microturbines.

The Optimization of Anaerobic Digestion Gas Production Selection Report shall include process flow diagrams for thermal hydrolysis and ultrasound pretreatment processes. The report shall also include cost estimates of the processes selected for optimization of anaerobic digestion gas production.

- Submit the draft report in accordance with the process described for reports in Attachment 3.

The deliverables are:

- ✓ Gas Cleaning Systems for Microturbines Selection Report.
- ✓ Optimization of Anaerobic Digestion Gas Production Selection Report.

Key Sub/Personnel: CH2M Hill/Bill Kitto and Fred Soroushian

Task 2.2.2: Site Selection and Test Plan

The Contractor Shall :

- Determine which microturbines and enhanced anaerobic digestion systems will be deployed at which selected site. The equipment in this project will be installed at host facilities. In the microturbine portion of this project the selected site will have gas production already available. In the anaerobic digester section of this project the selected site will have an operating digester.

In addition, the process flow diagrams produced in Task 2.2.1 will be expanded to depict how those processes will be integrated into the host facility. The contractor will work with host facility personnel in development of this integrated system.

- Prepare an Enhanced Energy Recovery through Optimization of Anaerobic Digestion and Microturbines Test Plan in accordance with the M&E plans (Task 1.1.13). The test plan shall be submitted to the Commission Contract Manager for comments and acceptances.

In the case of the microturbine application, gas sampling will be conducted prior to installation to determine gas quantity and quality. In addition, measurements will be taken to determine existing power generation and other gas utilization processes. Protocol will be developed for monitoring the performance of the microturbine and associated gas cleaning systems after installation.

Protocol will also be established for measuring gas quantity and quality during operation and for establishing emission rates and total emission levels.

The optimization of anaerobic digestion gas production system will also follow a similar set of activities where measurements are taken prior to equipment installation to establish a performance baseline for the digestion process. Flow rates and solids quality and quantity into the digester as well as gas production rates and solids quality, quantity, and dewaterability after digestion will be established. Protocols will be developed to measure these same parameters after installation of the digestion-enhancing equipment so that the impact of the new equipment on the system can be measured on a continuous basis. Measures of overall performance of the plant's digester system will also be collected.

- Prepare a Selection Report based on the above that includes the following:

- Process flow diagrams for thermal hydrolysis and ultrasound processes expanded to include integration into host facilities.
- Test plans for both microturbine and anaerobic digestion gas production systems.
- A summary table including results on sampling gas quantity (flow rate) and quality (gas composition including, not limiting CH₄, CO₂, H₂S, and siloxane) from selected existing facilities before installing microturbines.
- A summary table including monitoring results on flow rates, solids quality and quantity, digester loading rates, process recycles, and gas production before installing digester gas optimization processes.
- Material and energy balances for thermal hydrolysis and ultrasound processes expanded to include integration into host facilities.
- Recommendation for the processes to be used in the rest of this project.

Key elements from this report shall be included in the final report for this project.

The deliverables are:

- ✓ Draft Selection Report
- ✓ Final Selection Report
- ✓ Draft Enhanced Energy Recovery through Optimization of Anaerobic Digestion and Microturbines Test Plan
- ✓ Final Enhanced Energy Recovery through Optimization of Anaerobic Digestion and Microturbines Test Plan

Key Sub/Personnel: CH2M Hill/Bill Kitto and Fred Soroushian

Task 2.2.3a: Design Microturbine and Gas Cleaning Systems

The Contractor shall:

- Implement the system selected above through the preparation of a design suitable for the selected host facility. The Microturbine and Gas Cleaning System Design and Construction Drawings will integrate the microturbine and gas cleaning equipment including heat recovery into the particular requirements of the selected host facility. Mechanical, electrical, instrumentation/controls, and site/civil drawings will be prepared. These drawings will be suitable for construction.

The deliverables are:

- ✓ Microturbine and Gas Cleaning System Design and Construction Drawings
- ✓ Mechanical, Electrical, Instrumentation/Controls, And Site/Civil Drawings.

Key Sub/Personnel: CH2M Hill/Bill Kitto and Fred Soroushian

Task 2.2.3b: Design Thermal Hydrolysis and Ultrasound Systems

The Contractor shall:

- Prepare Thermal Hydrolysis and Ultrasound System Design and Construction Drawings. This design will include equipment specifications and drawings to facilitate installation of the anaerobic digestion gas production optimization equipment in the host facility. As in Task

2.2.3a, mechanical, electrical, instrumentation/controls, and site/civil drawings will be prepared for field installation where necessary. Prepackaged pilot units such as the thermal unit manufacturer's drawings and related information will be provided and a site plan for installation will be prepared. This task enables the selected systems to be implemented at the selected host facilities.

The deliverables are:

- ✓ Thermal Hydrolysis and Ultrasound System Design and Construction Drawings
- ✓ Mechanical, Electrical, Instrumentation/Controls, and Site/Civil Drawings.

Key Sub/Personnel: CH2M Hill/Fred Soroushian

Critical Project Review Meeting

Task 2.2.4a: Install Microturbine and Gas Cleaning Systems

The Contractor shall:

- Install the microturbine and associated gas cleaning systems in accordance with the design. In addition to its own engineering and construction forces, the vendor and host facility personnel will be involved in installation activities. Installation will be accomplished in accordance with all local codes and standard practices. Startup and testing of the microturbine and gas cleaning systems will also be undertaken in this task. Final activity in this task will be to prepare and submit to the Commission Contract Manager and the host facility As-Built Drawings for the Installed Microturbine and Gas Cleaning System
- Prepare Letter of Notification that the microturbine and gas cleaning systems are installed.

The deliverables are:

- ✓ Letter of Notification Installation of microturbine and gas-cleaning systems.
- ✓ As-Built Drawings for the Installed Microturbine and Gas Cleaning Systems.

Key Sub/Personnel: CH2M Hill/Bill Kitto and Fred Soroushian

Task 2.2.4b: Install Thermal Hydrolysis and Ultrasound Systems

The Contractor Shall:

- Install the Thermal Hydrolysis and Ultrasound Systems in accordance with the design and following the same approach as for the microturbine and gas cleaning system. The contractor will direct the installation activity, and staff from the vendors and host facilities will be involved. Startup and testing activities will begin and As-Built Drawings for the Installed Thermal Hydrolysis and Ultrasound Systems will be prepared where necessary.
- Prepare Letter of Notification that the thermal hydrolysis and ultrasound systems are installed.

The deliverables are:

- ✓ As-Built Drawings for the Installed Thermal Hydrolysis and Ultrasound Systems.
- ✓ Letter of Notification that the thermal hydrolysis and ultrasound systems are installed.

Key Sub/Personnel: CH2M Hill/Fred Soroushian

Task 2.2.5: Collect and Analyze Data for Microturbine and Gas Cleaning System and Optimized Anaerobic Digestion System

The Contractor shall:

- Submit Quarterly Data Report on data collection and analysis activities due within 30 days of quarter's end. Gas quantity and quality information will be collected before and after installation.

The data to be collected after installation to analyze the performance of the microturbine and associated gas cleaning systems include power generation, heat recovery, air emissions, construction costs, and operating costs. The equipment's performance will be measured in terms of heat rate, reliability, and emissions. Analyses will be conducted and compared to predicted values for these data.

The data will also be collected to analyze the effectiveness of the systems installed for anaerobic digestion gas production optimization. Information collected prior to installation on flow rates, solids quality and quantity, digester loading rates, process recycles, and gas production will be compared to similar data collected after installation. Installation, operation, and maintenance cost information will be collected. The analysis process will focus on determining the impact on process operation.

The deliverables are:

- ✓ a) First Quarterly Data Report on data collection and analysis activities.
- ✓ b) Second Quarterly Data Report on data collection and analysis activities.
- ✓ c) Third Quarterly Data Report on data collection and analysis activities.
- ✓ d) Fourth Quarterly Data Report on data collection and analysis activities.

Key Sub/Personnel: CH2M Hill/Bill Kitto and Fred Soroushian

Task 2.2.6: Prepare Final Report for Project 2.2

The Contractor shall:

- Prepare a Summary Report that shall include the results of the data and analysis work presented in Task 2.2.5. The Summary Report will also include a table that shows the improvement in the plan's performance after the installation of the microturbine and gas cleaning system. The economics of the each project will include not only the installation, operation, and maintenance costs, but the value of any environmental benefits achieved. Environmental benefits will include items that can be monetized quite easily such as emission credits. It will also present other information such as changes in greenhouse gas emissions that can be quantified but not as easily monetized. As with the microturbines and gas cleaning systems, the economics of the anaerobic digestion gas production optimization systems will also be presented.

The Final Report will be structured to clearly identify the extent to which the performance objectives are achieved for each project. It will also include a separate section specifically designed to help other sewage treatment plants take advantage of the lessons learned.

- Submit the report in accordance with the process described for reports in Attachment 4.
- Present the drawings of the microturbine and gas cleaning systems and the anaerobic digestion gas production optimization systems.

The deliverables are:

- ✓ a) Outline of the Final Report for Project 2.2
- ✓ b) Draft Enhanced Energy Recovery through Use of Microturbines and Optimization of Anaerobic Digestion Report
- ✓ c) Final Enhanced Energy Recovery through Use of Microturbines and Optimization of Anaerobic Digestion Report. Drawings on microturbine and gas-cleaning system and anaerobic digestion optimization systems.

Key Sub/Personnel: CH2M Hill/Bill Kitto and Fred Soroushian

Task 2.2.7: Coordinate with RPAC

The Contractor shall:

- Coordinate with RPAC. Committee representatives will be briefed at the beginning of this project and at the end of Task 2.2.2. A draft of the final report prepared in Task 2.2.6 shall be reviewed with the Committee before it is finalized.

The deliverables are:

- ✓ None.

Task 2.2.8: Evaluate Project

The Contractor shall:

- Evaluate this project in accordance with the M&E plan (Task 1.1.13).
- Evaluate the Project's achieved technical objectives and its contribution to the Program's stated objectives.
- Prepare the Enhanced Energy Recovery through Optimization of Anaerobic Digestion and Microturbines Evaluation Report.

The deliverables are:

- ✓ a) Draft Enhanced Energy Recovery through Use of Microturbines and Optimization of Anaerobic Digestion Evaluation Report
- ✓ b) Final Enhanced Energy Recovery through Use of Microturbines and Optimization of Anaerobic Digestion Evaluation Report

Key Sub: RER

WORK STATEMENT FOR PROJECT 3.1 - DAIRY WASTE TO ENERGY

GOALS AND OBJECTIVES

The goals of Dairy Waste to Energy project are to:

- Develop technologies that can be used to maximize the energy recovery from animal waste
- Develop and evaluate different pilot projects that will include facilities at existing treatment plants and at individual and clusters of dairies
- Evaluate and test the effectiveness of low and high technologies developed in North America and Europe for the collection processing and energy recovery of animal waste

The objectives of the project are to:

- Assess and evaluate technologies available for the conversion of animal waste to energy including:
 - Covered lagoons
 - High-rate phased digestion (North American)
 - European manure digestion technologies
 - Thermal hydrolysis
 - Pyrolysis
 - Heat Drying
- Select Sites for animal waste to energy pilot plant(s)
- Design, construct and operate pilot plant(s)
- Summarize and evaluate economic and environmental costs and benefits associated with developing an animal waste to energy facilities.

PROJECTED OUTCOMES

The Dairy Waste to Energy Project will generate the following specific work products: Process flow diagrams (which integrate the selected process advancements into the selected site) and preliminary facilities location plans depicting the conceptual layout of the pilot plant, the pilot plant test protocol Plan, performance specifications, site drawings, and one (or more) operating pilot plant(s) ranging in size from 60 kW to 5 MWs, with quarterly plant operating reports that document performance and needed modifications throughout the project.

TASK DESCRIPTIONS

Task 3.1.1: Assess, Evaluate, and Select Animal Waste to Energy Technology

The Contractor shall:

- Assess and evaluate animal waste to energy technologies from the various technologies that are available for the conversion of animal waste to energy. These technologies include:
 - Covered lagoons
 - High-rate, phased digestion (North American)
 - European manure digestion technologies
 - Thermal hydrolysis

- Pyrolysis
- Heat drying
- Gasification

Animal waste digestion results in a liquid slurry that is high in nutrients, as well as digested solids. Treatment alternatives for the sludge and the recycle streams will also be investigated and include the following:

- Membrane separation processes to separate solids and liquid streams, to separate nutrients from liquid stream and generate fertilizer and clean water
 - Evaluation of dewatering equipment, such as belt presses and centrifuges, to reduce the cost of subsequent handling and treatment
 - Treatment of recycle streams through chemical/biological processes
- Prepare Processes Recommendations Report. This report shall identify technologies evaluated, evaluation criteria, and results of comparative analysis of technologies, and make recommendations of the technologies and processes that will be used in the rest of this project.
 - Select the technologies and processes considering the comments received on the Processes Recommendations Report
 - Perform detailed system design, energy and material balances for the selected processes.

The deliverables are:

- ✓ a) Draft Processes Recommendations Report
- ✓ b) Final Processes Recommendations Report.
- ✓ c) Detailed system design, energy and material balances for the identified processes.

Key Sub/Personnel: CH2M Hill/Fred Soroushian

Task 3.1.2: Site Selection

The Contractor shall:

- Examine potential sites utilizing the information gathered in project 1.1. The selection process will need to consider the availability of sufficient area to accommodate the facilities required by the selected technologies, as well as the facilities for manure receiving and slurring. Some of the sites for facilities could include Regional Plant 1 (RP-1) and a Regional Plant 4 (RP-4), which are Inland Empire Utility Agency's wastewater treatment facilities, and the Teunissen Farm, and Chino Desalter site. These sites will be included in the analysis done in project 1.1.
- Select the sites.
- Prepare process flow diagrams depicting how the selected process will be integrated into the selected sites.
- Prepare preliminary facilities location plans showing the conceptual layout of pilot plant at the selected sites.

Prepare a Site Selection Report that fully documents the work in this task. Key elements from this report shall be included in the final report for this project.

The deliverables are:

- ✓ Site Selection Report

Key Sub/Personnel: CH2M Hill/Fred Soroushian

Task 3.1.3: Design the Pilot Plant(s) and Prepare Dairy Waste to Energy Test Plan

The Contractor shall:

- Design the pilot plant(s). A design will be prepared for the installation of the selected equipment for each of the technologies identified in Task 3.1.1, as well as the equipment necessary to receive, slurry, and screen or grind the manure for feed to the selected digester. The new equipment will be selected and sized for the project. Equipment specifications will be developed and drawings prepared to facilitate installation of the equipment. Energy and material balances for the identified processes will be updated.
- Prepare Pilot Plant(s) Design Report. The documentation will include facilities description; equipment type and sizing, process schematics, energy and material balances, piping and valves type and sizes; and facilities location and layout. In addition to the contractor's engineering and construction forces, vendor personnel, Inland Empire Utilities Agency staff, and dairy operators may be involved in the installation activities.
- Prepare a Dairy Waste to Energy Test Plan in accordance with the M&E plan described in Task 1.1.13. The plan will define the objectives and phases of the pilot testing, duration of each phase, and data collection needs. The plan will be used to establish the baseline conditions and measure the performance of the systems to be installed. Flow rates and solids quality and quantity into the digester, as well as gas production rates and solids quality, quantity, and dewaterability after digestion will be established. In addition, the plan will address data collection for the recycle streams and will specify the recording devices to measure output.

The deliverables are:

- ✓ Pilot Plant(s) Design Memorandum
- ✓ Draft Dairy Waste to Energy Test Plan
- ✓ Final Dairy Waste to Energy Test Plan

Key Sub/Personnel: CH2M Hill/Fred Soroushian

Critical Program Review Meeting

Task 3.1.4: Construct Pilot Plant(s)

The Contractor shall:

- Construct the pilot plant(s) in accordance with the design(s).
- Prepare Letter of Notification indicating that pilot plant construction is complete.
- Prepare performance specifications, site drawings, and initial performance results.

The deliverables are:

- ✓ a.1) A letter to notify pilot-scale reactor is installed, including pictures, notification letter, and applicable permits.
- ✓ a.2) A letter to notify energy recovery, prime mover and interconnection hardware is stalled including pictures, notification letter, and applicable permits.
- ✓ a.3) A letter to notify energy recovery, prime mover and interconnection hardware is stalled including pictures, notification letter, and applicable permits.
- ✓ b) Letter of Notification for Operating Pilot Plant operations support (on a monthly basis) that meets performance requirements (e.g. throughput, environmental requirements, waste processing, and gas production/energy recovery).
- ✓ c) Performance specifications, site drawings, and initial performance results.

Key Sub/Personnel: CH2M Hill/Fred Soroushian

Task 3.1.5: Operate and Test Pilot Plant(s)

The Contractor shall:

- Operate the plant(s) and conduct tests in accordance with the test plan. The equipment will be operated and the performance data (Table 3.1-1) will be collected and compiled for each technology, as well as information for construction and operation and maintenance costs. In addition, data will also be collected on biogas generation rate (ft³/day/lb TS), volatile solids reduction, and biogas composition including CH₄, CO₂, H₂S, and others.
- Prepare bi-monthly Plant Operating Data Reports to verify that the Pilot Plant meets performance requirements (e.g., throughput, environmental requirements, waste processing, and gas production/energy recovery). This will include pilot plant operations support (on a quarterly basis) that meets performance requirements (e.g., throughput, environmental requirements, waste processing, and gas production/energy recovery).

The deliverables are:

- ✓ Bi-Monthly Plant Construction and Operating Data Reports

Key Sub/Personnel: CH2M Hill/Fred Soroushian

Table 3.1-1: Digester Performance Criteria

Manure input	Flow (GPD)	BOD (Lbs/Day)	TS (Lbs/Day)	VS (Lbs/Day)	Solids (%)
Dairy washwater					
Wet manure					
Dry manure					
Total					
Digester	Units				
Digester Loading Rate	Lb TS/day/ft3 digester volume				
Hydraulic Retention Time	days				
Digester Temperature	C				
pH changes over time					
Performance					
Volatile Solids (VS) Reduction	VS in Output/VS in Input, %				
Biogas Production Rate	Ft3 biogas/day/lb TS				
CH4 in Biogas	%				
CO2 in Biogas	%				
H2S in Biogas	%				

Task 3.1.6: Conduct Economic and Environmental Assessment**The Contractor shall:**

- Conduct an economic and environmental assessment based on the results of the pilot test operation.
- Prepare economic assessment and environmental assessment reports.

The economic assessment report will consist of the preparation of an order of magnitude cost estimate for the construction and operation of a full-size facility that is regionalized at the treatment facility, as well as a similar cost estimate for smaller farm-based facilities. Engineering/Economic Consideration, Electricity production, Total capacity (MW), Average annual output (\$), Capital cost (\$), Annual O&M (\$/year), Environmental benefits (\$), Total lifecycle cost (\$), Rate of return (percent) will be assessed in this analysis. In addition, the pilot testing data will be used to conduct an environmental assessment to determine the changes in air emissions, total dissolved solids (TDS) and nitrate loading on groundwater, and watershed improvements that will result from processing the animal waste for energy recovery. The report will also include the cost and effectiveness of the various technologies will be measured in terms of each system's total installed and operating cost over the project's life as a centralized system and as a smaller, farm-based system. In addition, the operation and maintenance costs will be prepared using well-defined metrics to facilitate a standardized comparison of the costs. Economic and engineering information on the technology's performance will be collected and presented as shown in Table 3.1-3.

The environmental assessment report will include comparing the potential environmental benefits of reduced emissions associated with reduced on-site storage of material and reduced truck traffic as compared to the current practice. It is believed that emission credits can be a very significant and valuable environmental benefit. Performance information will be collected and presented for environmental measures as shown in Table 3.1-2.

The deliverables are:

- ✓ a) Draft Economic and Environmental Assessment Report.
- ✓ b) Final Economic and Environmental Assessment Report.

Key Sub/Personnel: CH2M Hill/Bill Kitto and Fred Soroushian

Table 3.1-2: Environmental Performance Criteria

Environmental Benefits	Theoretical Potential	Existing Situation	Demonstrated Performance
Methane production (tons/year)			
CO ₂ equivalent of CH ₄ reduction (tons/year)			
CO ₂ emissions (tons/year)			
Generated through energy recovery			
Reduced truck traffic			
NO _x emissions (tons/year)			
Generated through energy recovery			
Reduced truck traffic			
SO ₂ emissions (tons/year)			
Generated through energy recovery			
Reduced truck traffic			
Ammonia emissions (tons/year)			
Reduced from dairy stockpiles			
TDS reduction in groundwater (tons/year)			
Nitrate reduction in groundwater (tons/year)			

Table 3.1-3: Engineering and Economic Metrics

Engineering/Economic Consideration	Existing	Centralized Treatment Facility	Farm-Based Treatment Facilities
Electricity production			
Total capacity (MW)			
Average annual output (\$)			
Capital cost (\$)			
Annual O&M (\$/year)			
Environmental benefits (\$)			
Total lifecycle cost (\$)			
Rate of return (percent)			

Task 3.1.7: Prepare Final Report for Project 3.1

The Contractor shall:

- Prepare the Dairy Waste to Energy Summary Report that will present the results and analyses of the pilot tests. It will provide a summary of Tasks 3.1.1 through 3.1.6. The economics of each project will include the installation, operation, maintenance costs, and the value of any environmental benefits achieved. Environmental benefits will include items that can be monetized easily, such as emission credits. It will also include other information such as changes in greenhouse gas emissions that can be quantified but not as easily monetized.

The Project Report will be structured to clearly identify the extent to which the performance objectives are achieved for each pilot test. In addition, the Project Report will present any recommendations that arise out of the animal waste to energy recovery pilot tests, to include the identification of pilot tested technologies that achieve the goal of maximizing energy recovery, the cost-effectiveness of centralized versus farm-based treatment facilities, and any additional testing requirements that may be required.

The Final Report shall also include plant drawings, operating procedures, and history of the project.

- Submit the draft report in accordance with the process described for reports in Attachment 3.

The deliverables are:

- ✓ a) Outline for the Final Report for Project 3.1
- ✓ b) Draft Dairy Waste to Energy Report
- ✓ c) Final Dairy Waste to Energy Report

Key Sub/Personnel: CH2M Hill/Bill Kitto and Fred Soroushian

Task 3.1.8: Coordinate with Renewables Project Advisory Committee

The Contractor shall:

- Brief Committee representatives at the beginning of this project and at the end of Task 3.1.3. A draft of the summary report prepared in Task 3.1.7 shall be reviewed with the Committee before it is finalized.

The deliverables are:

- ✓ None

Task 3.1.9: Evaluate Project

The Contractor shall:

- Evaluate this project in accordance with the M&E plan (Task 1.1.13).

- Evaluate project's achieved technical objectives and its contribution to the Program's stated objectives
- Prepare the Dairy Waste to Energy Evaluation Report.

The deliverables are:

- ✓ a) Draft Dairy Waste to Energy Project Evaluation Report
- ✓ b) Final Dairy Waste to Energy Project Evaluation Report

Key Sub/: RER

WORK STATEMENT FOR PROJECT 3.2 - BUILDING INTEGRATED PV TESTING AND EVALUATION

GOALS AND OBJECTIVES

The goals of Building Integrated PV Testing and Evaluation project are to:

- Address the gap between future third-party certified PV component and system performance results and currently available information from manufacturers
- Provide an independent comparative evaluation of PV systems critical to Project 3.3 and to the Commission Buydown Program
- Provide decision-making information on those PV systems.
- Improve the quality of systems installed in Project 3.3 through directed training

The objectives of this project are to:

- Select, procure, install, and evaluate three candidate PV Systems for implementing Project 3.3 BIPV on Public Buildings
- Determine flaws, weak points, poor design features, etc. and offer suggested fixes
- Evaluate selection, ease of installation, performance, other issues that may impact life-cycle costs
- Monitor and report on system performance for 12 months
- Develop recommendations for system purchases.

PROJECTED OUTCOMES

The Building-Integrated Photovoltaic Testing and Evaluation Project will yield a Consumer Reports-type rating manual that can be used by manufacturers, system integrators and customers to guide the selection and design of building-integrated photovoltaic systems. This manual will contribute the achievement of two program objectives to demonstrate the use of proper systems integration to enhance the performance of photovoltaic systems; and to demonstrate the use of a basic rating system to improve the flow of information on photovoltaic system performance.

TASK DESCRIPTIONS

3.2.1 Building Integrated PV Testing and Evaluation Test Plan

The Contractor shall:

- Prepare a Building Integrated PV Testing and Evaluation Test Plan in accordance with the guidelines in Attachment 3. The test plan shall be prepared in coordination with the M&E plan described in Task 1.1.14 Key elements from this test plan shall be included in the final report for this project.
- Submit the test plan to the Commission Contract Manager for comments and acceptances

The Deliverables are:

- ✓ Draft Building Integrated PV Testing and Evaluation Test Plan
- ✓ Final Building Integrated PV Testing and Evaluation Test Plan

Key Sub/Personnel: Endecon Engineering/Chuck Whitaker

Task 3.2.2 Comprehensive PV System Comparison

Task 3.2.2a Comprehensive Large PV System Comparison

The Contractor shall:

- Select three samples of 20 kW large PV systems in accordance with the Program M&E Plan.
- Purchase and install the selected systems. Systems will be bought from dealers, distributors, or otherwise in such a way as to ensure that the components are *not specially selected by the supplier*. If not recently characterized, one or two modules from each system will be sent to National Renewable Energy Laboratory (NREL) or Sandia for characterization. These characterizations will establish baseline performance of these critical components as well as system modeling parameters for the further evaluation.

Once the components have been characterized and any identified system deficiencies are corrected, the system will be installed per the supplier's specifications using one of two options. Option 1 includes installing the systems on new or existing structures in the Emerging Module Technology (EMT) field at Photovoltaics for Utility Systems Applications (PVUSA) and connecting them to existing data monitoring equipment. Option 2 includes installing one or more of the systems directly on Commonwealth Program Participant buildings, along with the necessary data monitoring equipment.

- Evaluate the installed systems in accordance with the evaluation plan.

The systems will be operated normally and continuously monitored.

- Perform PV System Design, project permitting and equipment acquisition,
- Prepare an Initial Characterization Report, which shall include documentation evaluation, and initial performance data.

Critical Project Review

- Prepare a 6-Month Exposure and Operation Report summarizing the results of the first 6 months of operation. This information will provide feedback to the equipment suppliers, installers, and program team.
- Prepare an Interim Exposure and Operations report
- Prepare a 12-Month Exposure and Operation Report summarizing the results of the first 12 months of operation. This information will provide feedback to the equipment suppliers, installers, and program team.
- Prepare Consumer Confidence Guidelines for energy production of PV systems.

The system capital costs will be covered by the Contractor match funds.

The Deliverables are:

- ✓ System site selection, permitting and acquisition.
- ✓ Data acquisition System (DAS) letter of Notification.
- ✓ Initial Characterization Report for First System
- ✓ Initial Characterization Report for Second System
- ✓ Initial Characterization Report for Third System
- ✓ 6-Month Exposure and Operation Report
- ✓ Interim Exposure and Operations report
- ✓ 12-Month Exposure and Operation Report
- ✓ Consumer Confidence Guidelines for energy production of PV systems

Task 3.2.2b Comprehensive Small PV System Comparison

The Contractor shall:

- Select three or four samples of 1-2 kW small PV systems relevant to the California PV market in accordance with the Program M&E Plan and selection criteria including thoroughness of documentation, materials used, mounting hardware, ease of installation, maintainability, and performance.
- Purchase and install the selected systems. These systems will be pre-engineered (EarthSafe, PV+Plus, Sunline/SunUPS, Solar Energizer, etc.) systems that are offered by manufacturers and system integrators in sufficient quantity as to make them readily available throughout the state. Documentation review, similar to the method being used by the Florida Solar Energy Center (FSEC) (code compliance, installation issues, ease of installation, quality of design, etc.). The Contractor will work cooperatively with FSEC to maximize the efficiency of the evaluation process and share results.
- Evaluate the installed systems in accordance with the evaluation plan.

The systems will be operated normally and continuously monitored.

- Perform PV System Design, project permitting and equipment acquisition,
- Prepare an Initial Characterization Report, which shall include documentation evaluation, and initial performance data.

Critical Project Review

- Prepare a 6-Month Exposure and Operation Report summarizing the results of the first 6 months of operation. This information will provide feedback to the equipment suppliers, installers, and program team.
- Prepare an Interim Exposure and Operations report

- Prepare a 12-Month Exposure and Operation Report summarizing the results of the first 12 months of operation. This information will provide feedback to the equipment suppliers, installers, and program team.
- Prepare Consumer Confidence Guidelines for energy production of PV systems.

The Deliverables are:

- ✓ System site selection, permitting and acquisition.
- ✓ Data acquisition System (DAS) letter of Notification.
- ✓ Initial Characterization Report for First System.
- ✓ Initial Characterization Report for Second System.
- ✓ Initial Characterization Report for Third System.
- ✓ 6-Month Exposure and Operation Report
- ✓ Interim Exposure and Operations report
- ✓ 12-Month Exposure and Operation Report
- ✓ Consumer Confidence Guidelines for energy production of PV systems

Key Sub/Personnel: Endecon Engineering/Chuck Whitaker

Task 3.2.3 Technology Transfer

The Contractor shall:

- Provide a PV System Evaluation web page with links. The web page shall include system performance reports as well as some real-time data. The web page shall be located on the Commission PIER website. Subscribers who desire to be kept up to date on this information can be notified when significant updates are made to the website.
- Prepare Technical Papers and Presentations that will be given at major meetings, conferences, and workshops.
- Conduct a series of workshops to provide consumers and installers with test results from the evaluation testing. Four 3-day in depth workshops that describe the ongoing testing will be given during the course of this project. These workshops will provide program installers and maintenance personnel, as well as other installers and interested consumers, hands-on experience with the systems under test.

The deliverables are:

- ✓ Initial Web Page Design
- ✓ Web Page updates for all Systems w/links.
- ✓ Technical Papers and Presentations
- ✓ Four 3-day workshops

Key Sub/Personnel: Endecon Engineering/Chuck Whitaker

Task 3.2.4 Final Report for Project 3.2

The Contractor shall:

- Prepare a Building Integrated PV Testing and Evaluation Final Report that fully documents the work in this project.
- Submit the draft report in accordance with the process described for reports in Attachment 3.

The Deliverables are:

- ✓ Outline of the Final Report for Project 3.2
- ✓ Draft Building Integrated PV Testing and Evaluation Report
- ✓ Final Building Integrated PV Testing and Evaluation Report

Task 3.2.5 Coordinate with the Renewables Project Advisory Committee

The Contractor shall:

- Brief Committee representatives at the beginning of this project and in conjunction with the 6-Month Report. A draft of the final report prepared in Task 3.2.2 shall be reviewed with the Committee before it is finalized.

The deliverables are:

- ✓ Final Presentation /Letter of Notification

Task 3.2.6 Evaluate Project

The Contractor shall:

- Evaluate the project in accordance with the evaluation plan.
- Prepare Project Evaluation Report based on the above.

The deliverables are:

- ✓ a) Draft Project Evaluation Report.
- ✓ b) Final Project Evaluation Report.

Key Sub: RER

WORK STATEMENT FOR PROJECT 3.3 - BUILDING INTEGRATED PV ON PUBLIC FACILITIES

GOALS AND OBJECTIVES

The goal of Building Integrated PV on Public Facilities project is to demonstrate the potential for taking advantage of affordability improvements and value added applications by demonstrating a number of new and repeatable project development approaches in public facilities with relatively large building integrated PV systems. The primary purpose of each of these pilot demonstrations is to validate ways in which building integrated PV systems can be developed and installed by ESPs, public entities, or building owners including approaches that can: 1) improve consumer affordability to these higher cost systems, 2) reduce installed PV costs per peak watt (and per life cycle kWh) and, 3) separately, find ways to add outside inherent value to the PV system installation over its life (i.e., through dual- or tri-use applications of the system).

PROJECTED OUTCOMES

The Building Integrated PV on Public Facilities Project will yield a set of specific photovoltaic facilities expected to range in size from 10 kW up to 150 kW, each addressing an infrastructure or commercialization barrier. Thus achieving the PIER objective of demonstrating the potential for taking advantage of cost economies by installing relatively large PV systems with at least one under common ownership arrangements. The cumulative capacity of BI-PV systems expected to be procured and installed under this program element ranges from 120 to 300 kW.

TASK DESCRIPTIONS

Task 3.3.1a: Compile database of Public Sector Clients

The Contractor shall:

- Prepare Public-Sector Agencies Database. The public sector agencies in the mini-grid area will be identified and organized in this project database. Information regarding facilities and load profiles will be used to identify potential facilities for demonstration projects.

The deliverables are:

- ✓ Public-Sector Agencies Database

Key Sub/Personnel: REDI/Keith Rutledge

Task 3.3.1b: Compile Database of BI-PV Equipment Vendors and Service Providers

The Contractor shall:

- Prepare a Manufacturers and Distributors of BI-PV Equipment Database. Manufacturers and distributors of BI-PV equipment along with dealers offering installation services will be

evaluated and contacted to negotiate discount pricing for aggregated volume. Technology improvements capable of enhancing existing facilities will be researched and evaluated. The data base shall include demand- and supply-side stakeholders, including sites, solar resources, product suppliers and installation contractors

The deliverables are:

- ✓ Manufacturers and Distributors of BI-PV Equipment Database

Key Sub/Personnel: REDI/Keith Rutledge

Task 3.3.2: Develop Evaluation Tools

The Contractor shall:

- Develop software to compile and analyze site data, estimate system performance, perform financial analysis, and quantify environmental benefits. Renewable resources, both existing and new, will be identified in target areas. Optimum resource and generation technology matches will be determined.
- Prepare a BI-PV Evaluation Tools Package including energy audit forms, financial analysis spreadsheets, technical assistance booklets, and project development guidelines.
- Prepare a Building Integrated PV on Public Facilities Test Plan. The test plan shall be prepared in coordination with the M&E plan described in Task 1.1.13.

The deliverables are:

- ✓ BI-PV Evaluation Tools Package
- ✓ Draft BI-PV on Public Facilities Test Plan
- ✓ Final BI-PV on Public Facilities Test Plan

Key Sub/Personnel: REDI/Keith Rutledge

Task 3.3.3: Establish BI-PV Public Sector Loan Program [Note: Dropped from PIER Funding -- Match Funds use only]

The Contractor shall (with match funds only):

- Facilitate Rural Alliance Inc. (RAI) development of a BI-PV Public Sector Loan Program. The California Local Government Finance Authority has access to long-term low-interest bond funds. RAI will develop a loan fund to service the needs of public sector clients to finance BI-PV systems at new and existing facilities. This program will be a tax-exempt bond financing pool with a vendor financing mechanism for leasing BI-PV systems to end users. Loan origination and servicing is designed to be provided through the vendor or contractor.

The deliverables are (If funded by Matching fund sources):

- ✓ BI-PV Public Sector Loan Program

Key Sub/Personnel: REDI/Keith Rutledge

Task 3.3.4a: Select Demonstration Project Sites

The Contractor shall:

- Identify, based upon information obtained in Project 1, potential project sites for feasibility of BI-PV systems.
- Narrow down the potential sites to 4.
- Once projects have been qualified, design and engineering services will develop plans for these 4 sites.
- Prepare a Demonstration Site Selection Report. This report shall document the work of this task and shall include the plans for each site.

The deliverables are:

- ✓ Demonstration Site Selection Report

Key Sub/Personnel: REDI/Keith Rutledge

Critical Project Review

Task 3.3.4b: Finance and Construct BI-PV Systems

The Contractor shall:

- Provide financing for the 4 sites as needed. A variety of financing models will be pursued, including long-term leases offered by vendors.
- Install four BI-PV systems based upon the financial, technical and design work tasks above.
- Prepare Letters of Notification indicating that 4 BI-PV systems have been financed and installed.

The deliverables are:

- ✓ Letters of Notification of receiving finance for system No.1.
- ✓ Copy of permit(s) for system No.1. (Project #3.3 PV @30kW).
- ✓ Letters of Notification of finishing installation for system No.1/Initial Performance Results.
- ✓ Letters of Notification of receiving finance for system No.2.
- ✓ Copy of permit(s) for system No. 2. Letters of Notification of finishing installation for system No.2/Initial Performance Results.
- ✓ Letters of Notification of receiving finance for system No.3.
- ✓ Copy of permit(s) for system No. 3. Letters of Notification of finishing installation for system No.3/Initial Performance Results.
- ✓ Letters of Notification of receiving finance for system No.4.
- ✓ Copy of permit(s) for system No. 4. Letters of Notification of finishing installation for system No.4/Initial Performance Results.

Key Sub/Personnel: Max Carpenter (Commonwealth Energy) REDI/Keith Rutledge

Task 3.3.4c: System Monitoring

The Contractor shall:

- Monitor and determine energy output for the 4 completed BIPV systems in accordance with the evaluation plan. Long-term monitoring and evaluation of demonstration systems will serve to support technology transfer efforts throughout the state over the next five, ten, and fifteen years.
- Prepare Semi-Annual Reports of Monitoring Data on 4 Demonstration Systems. These reports are due within 30 days after the end of each period.

The deliverables:

- ✓ Semi-Annual Reports of Monitoring Data on all Demonstration Systems

Key Sub/Personnel: REDI/ Keith Rutledge / RER/Patrick Lilly

Task 3.3.5: Prepare Final Report for Project 3.3

The Contractor shall:

- Prepare the Building Integrated PV on Public Facilities Summary Report, addressing the technical as well as financial aspects of the work performed. Regulatory issues that are identified and addressed will be discussed along with evaluation of procedures used in project evaluations. The report will also summarize the technical and financial work done to design, finance, and install the BIPV system and present pertinent installation, operation, and maintenance costs.
- Submit the draft report in accordance with the process described for reports in Attachment 3.

The deliverables are:

- ✓ Outline of the Final Report for Project 3.3
- ✓ Draft Building Integrated PV on Public Facilities Report
- ✓ Final Building Integrated PV on Public Facilities Report

Key Sub/Personnel: REDI/ Keith Rutledge

Task 3.3.6: Coordinate with Renewables Project Advisory Committee

The Contractor shall:

- Brief Committee representatives at the beginning of the project and during task 3.3.4. A draft of the final report prepared in Task 3.3.5 will be reviewed with the Committee before it is finalized.

The deliverables are:

- ✓ None.

Task 3.3.7: Evaluate Project

The Contractor shall:

- Evaluate this project in accordance with the evaluation plan (1.1.13).
- Prepare a Building Integrated PV on Public Facilities Project Evaluation Report.

The deliverables are:

- ✓ a) Draft Building Integrated PV on Public Facilities Project Evaluation Report.
- ✓ b) Final Building Integrated PV on Public Facilities Project Evaluation Report.

Key Sub/: RER